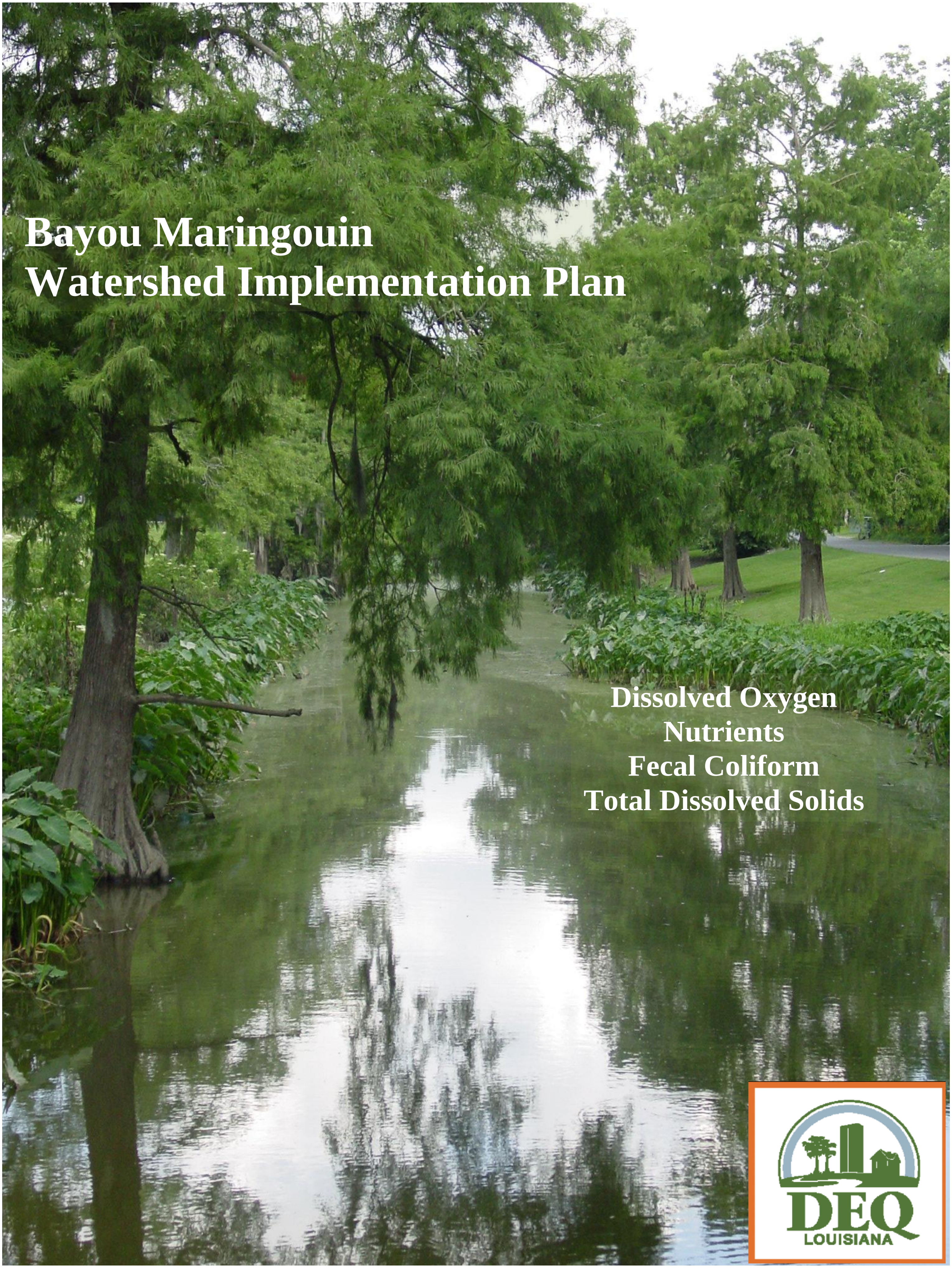
Bayou Maringouin
Watershed Implementation Plan



Dissolved Oxygen
Nutrients
Fecal Coliform
Total Dissolved Solids

DEQ
LOUISIANA

Cover photo: View of Bayou Maringouin from the newly constructed footbridge.

Figure 1. The new footbridge crossing over Bayou Maringouin, constructed in summer 2008.

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List of Abbreviations

BMP .... Best Management Practice
CWA...................... Clean Water Act
DO......................... Dissolved Oxygen
EABPL .... East Atchafalaya Basin Protection Levee
EPA........................ Environmental Protection Agency
FSA........................ Farm Security Administration
GPS .... Global Positioning Systems
LA .... Load Allocations
LCES .... Louisiana Cooperative Extension Service
LDAF .... Louisiana Department of Ag and Forestry
LDEQ...................Louisiana Department of Environmental Quality
LDNR.................... Louisiana Department of Natural Resources
MOS...................... Margin of Safety
NPS .... Nonpoint Source
NRCS.................... Natural Resources Conservation Service
SOD .... Sediment Oxygen Demand
SWCD................... Soil and Water Conservation District
TKN .... Total Kjeldahl Nitrogen
TMDL................... Total Maximum Daily Loads
USDA.................... United States Department of Agriculture
WLA...................... Waste Load Allocations

Figure 2. The weir on Bayou Maringouin surrounded by nonnative elephant ears.

1.0 INTRODUCTION

Louisiana contains extensive areas of waterbodies, including wetlands, bayous, rivers and lakes. Surface water in Louisiana is used for a wide variety of purposes such as drinking water, agricultural irrigation, transportation, industrial processes, recreation, seafood production, and wildlife habitat. A great portion of the Louisiana economy and cultural heritage is directly linked to the surface water resources that exist today.

Nonpoint source pollution is a diffuse source of water pollution that occurs when stormwater flows across the land, transporting contaminants to a waterbody. Common land-use categories that contribute to nonpoint source pollution include agriculture, forestry, urban runoff, construction, home sewerage systems, resource extraction, and hydromodification. Detailed explanations of each category can be found in the State of Louisiana Water Quality Management Plan, Volume 6, Louisiana's Nonpoint Source Management, 2000.

Historically, Bayou Maringouin (subsegment 120111) may have been a constantly flowing stream, but now its main use is that of a drainage ditch. With the designated uses assigned to this bayou, it may be difficult or impossible for a drainage ditch to meet the stringent water quality criteria that come with these uses by using standard Best Management Practices. It may be necessary to use more drastic techniques to restore the uses of Bayou Maringouin, such as fresh water diversion.

The purpose of this report is to explain the water quality problems in Bayou Maringouin and describe the BMPs and programs available to correct these problems. The problems are addressed by reducing the amount of nonpoint source pollution entering the bayou and thereby increasing water quality to a level where the waterbody fully meets its designated uses.

Section 319 of the Clean Water Act (CWA) authorizes the Environmental Protection Agency (EPA) to issue grants to states to assist in implementing management programs to control nonpoint sources of water pollution. The 303(d) list of impaired waterbodies consists of those waterbodies that do not meet state regulatory water quality standards even with the current pollution controls in place and after point sources of pollution have installed the minimum levels of pollution controls.

The Bayou Maringouin Watershed is on this 303(d) list and is listed as not supporting its designated uses of Primary Contact Recreation and Fish and Wildlife Propagation; however it was fully supporting its use of Secondary Contact Recreation. The Louisiana Department of Environmental Quality (LDEQ) has developed Total Maximum Daily Loads (TMDLs) for both nutrients and dissolved oxygen. EPA has developed TMDLs for fecal coliform and total dissolved solids. TMDLs provide reduction goals for point and nonpoint source loading into the waterbody.

Figure 3. Cypress knees and overabundant elephant ears along Bayou Maringouin.

Figure 4. Bayou Maringouin along Overton Road is protected from erosion by cattle fencing.

1.1 Ecoregion Description

The Bayou Maringouin Watershed is located in the Lower Mississippi River Alluvial Plain ecoregion. The soil's drainage is poor and natural vegetation includes oak, tupelo, baldcypress, and bottomland hardwoods. The soil associations in this ecoregion include the alluvium soils from the Mississippi River with some Gulf Coast Flatwood soils. Land use in this ecoregion consists of cropland, grazing land, pasture, woodland and forest (LDEQ, 1992).

1.2 Terrebonne Basin Description

The Bayou Maringouin Watershed is located in the northwest corner of the Terrebonne Basin. From the Mississippi River to the Gulf of Mexico, the Terrebonne Basin covers an area extending approximately 120 miles and varies in width from 18 to 70 miles. The Terrebonne Basin is bordered on the west by the Atchafalaya River Basin, on the east by the Mississippi River and Bayou Lafourche, and on the south by the Gulf of Mexico. The topography of the entire basin is lowland, and all the land is subject to flooding except the natural levees along major waterways. The coastal portion of the basin is prone to tidal flooding and consists of marshes ranging from fresh to saline (LDEQ, 1996).

Table 1. Terrebonne Basin Land Use

Land Use	Acres	Percent
Wetland	881,214	35.19
Water	870,613	34.76
Agriculture	396,369	15.83
Forest	256,175	10.23
Urban	99,885	3.99
Total	**2,504,256**	**100%**

More than half of the Terrebonne Basin is classified as either wetland or water. Agriculture is usually limited to the natural levees of the Mississippi River, Bayou Lafourche, and its distributaries. The area between these natural levees is mostly covered by fresh water swamps in the northern area and marshes in the south.

2.0 WATERSHED LAND USE

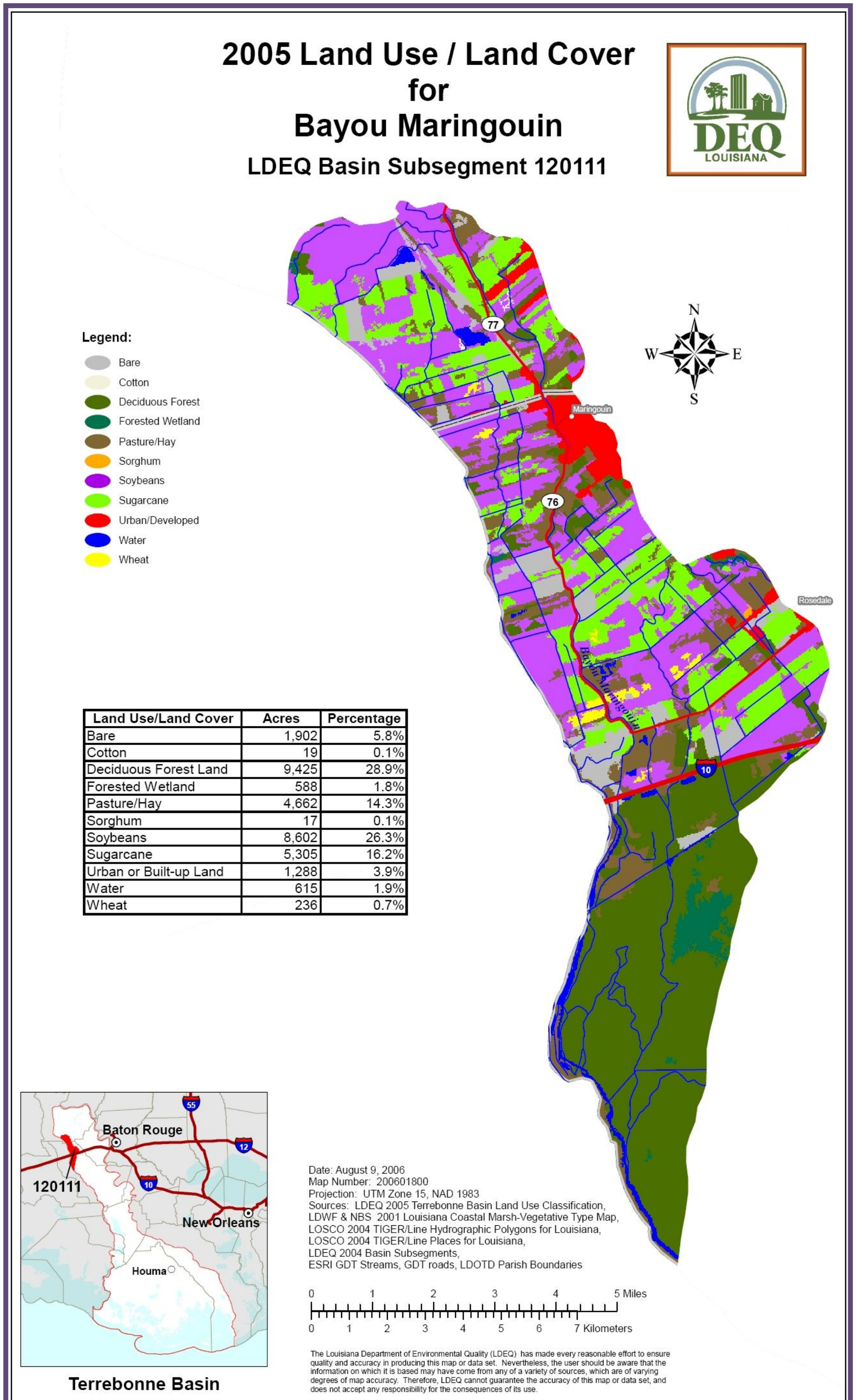
Land use in the Bayou Maringouin Watershed is largely agriculture, with the primary crops being soybeans, sugarcane, and pastureland. The majority of the agriculture is located in the modeled portion of the watershed, north of I-10. Except for the town of Maringouin, Bayou Maringouin flows through agricultural fields during its entire path from the headwaters to I-10. Soybean and sugarcane fields lie along a majority of the banks of Bayou Maringouin.

Urban areas are concentrated in the town of Maringouin, with many residences along the bank of Bayou Maringouin. The rest of the bayou has houses along its bank, but at a much lower density than in the town of Maringouin. The portion of the watershed that was not modeled, south of I-10, is almost entirely forest land and wetland.

Table 2. Bayou Maringouin Watershed Land Use

Agricultural Land Use	Acres	Percent
Soybeans	8,602	26.3%
Sugarcane	5,305	16.2%
Pasture/Hay/Idle	4,662	14.3%
Bare	1,902	5.8%
Wheat	236	0.7%
Cotton	19	0.1%
Sorghum	17	0.1%
Subtotal	**20,743**	**63.5%**
Non-agricultural Land Use	**Acres**	**Percent**
Deciduous Forest	9,425	28.9%
Forested Wetland	588	1.8%
Urban	1,288	3.9%
Water	615	1.9%
Total	**32,659**	**100%**

Figure 5. A vegetated ditch (right foreground) drains a sugarcane field (left) and the Livonia Hump Yard (background) into Bayou Maringouin.



Land Use/Land Cover	Acres	Percentage
Bare	1,902	5.8%
Cotton	19	0.1%
Deciduous Forest Land	9,425	28.9%
Forested Wetland	588	1.8%
Pasture/Hay	4,662	14.3%
Sorghum	17	0.1%
Soybeans	8,602	26.3%
Sugarcane	5,305	16.2%
Urban or Built-up Land	1,288	3.9%
Water	615	1.9%
Wheat	236	0.7%

Figure 6. Land Use Map of the Bayou Maringouin Watershed.

2.1 Maringouin Watershed Description

The size of the Bayou Maringouin subsegment is approximately 51 square miles. The modeled portion of Bayou Maringouin is 18.1 kilometers long from its headwaters in Valverda to the Ramah Canal just north of I-10 (Figure 8). This stretch of Bayou Maringouin drains almost entirely into the East Atchafalaya Basin Protection Levee (EABPL) Borrow Pits via the Ramah Canal. There is one unnamed tributary to Bayou Maringouin, which is located about 4.5 kilometers from its headwaters. Bayou Maringouin continues south of the Ramah Canal, but this section of the bayou was not assessed by LDEQ and not included in the TMDL model (Figure 9).

The eastern border of the subsegment runs along Bayou Grosse Tete, which is a more substantial water body than Bayou Maringouin in volume and length. Despite the close proximity, particularly near the headwaters of Bayou Maringouin, the two bayous are not hydrologically connected.

The western border of the Bayou Maringouin subsegment is formed by the EABPL Borrow Pits. The borrow pits are a continuous body of water that form well above the subsegment and flow in a southerly direction where they eventually become the Intracoastal Waterway. This body of water is more substantial in volume and length than Bayou Maringouin. All of Bayou Maringouin's flow enters the borrow pits at either the Ramah Canal north of I-10, the King Ditch south of I-10, or the confluence of Bayou Maringouin with the borrow pits near the bottom of the subsegment.

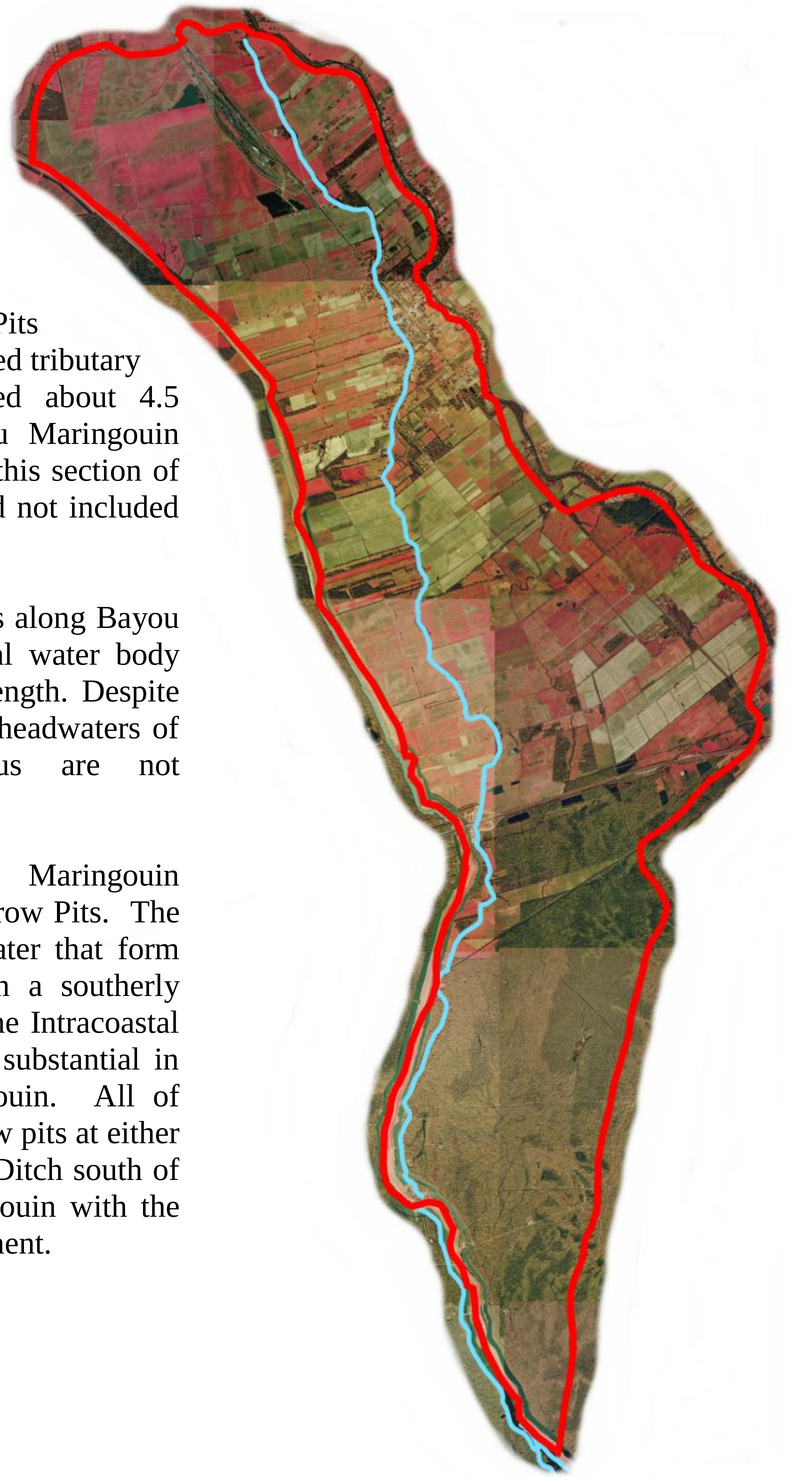


Figure 7. Satellite imagery of Bayou Maringouin (blue) and its watershed boundaries (red).

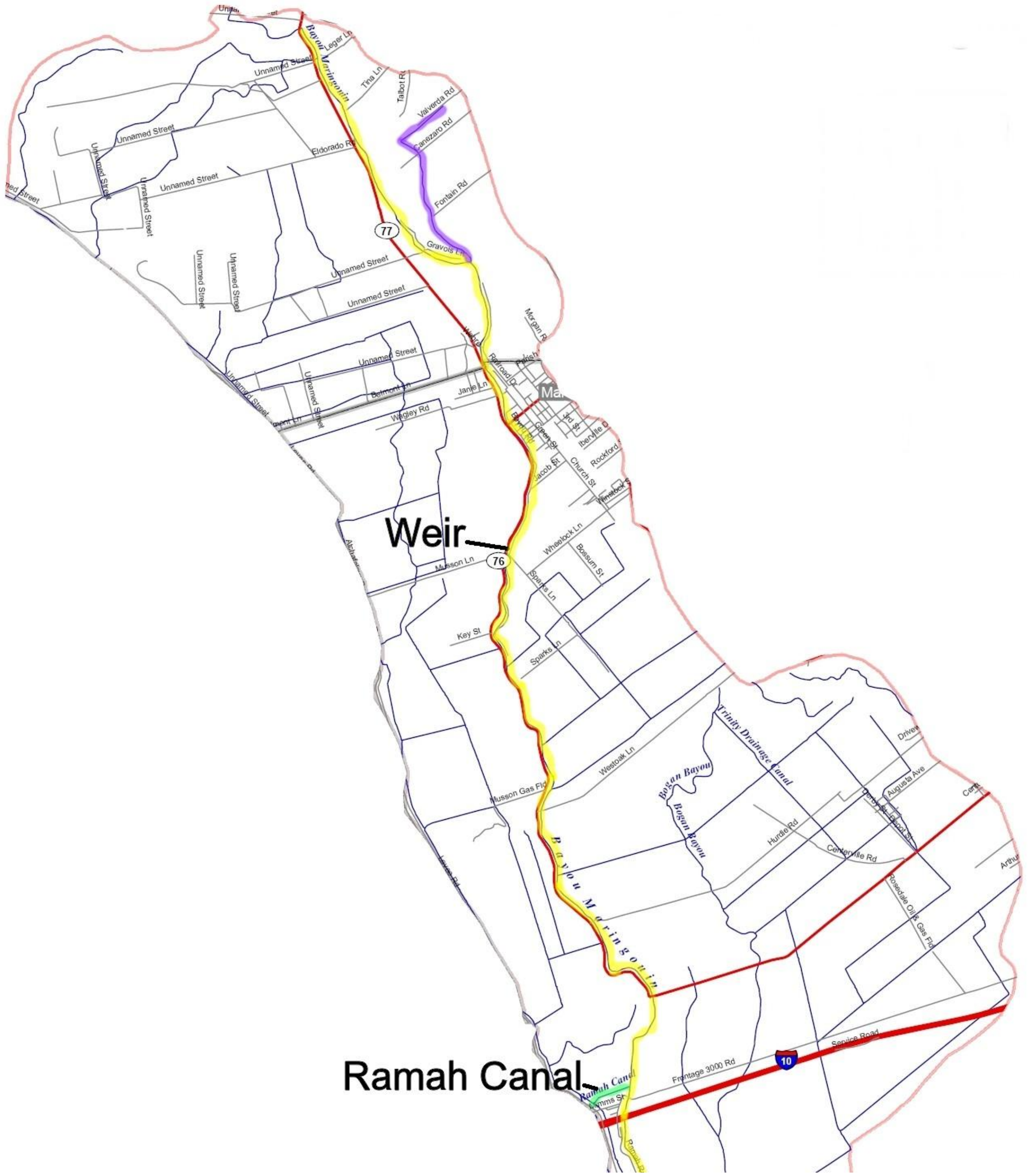


Figure 8. Modeled portion of Bayou Maringouin (yellow), from headwaters to Ramah Canal (green), showing location of the Weir, unnamed tributary (purple), and Ramah Canal.

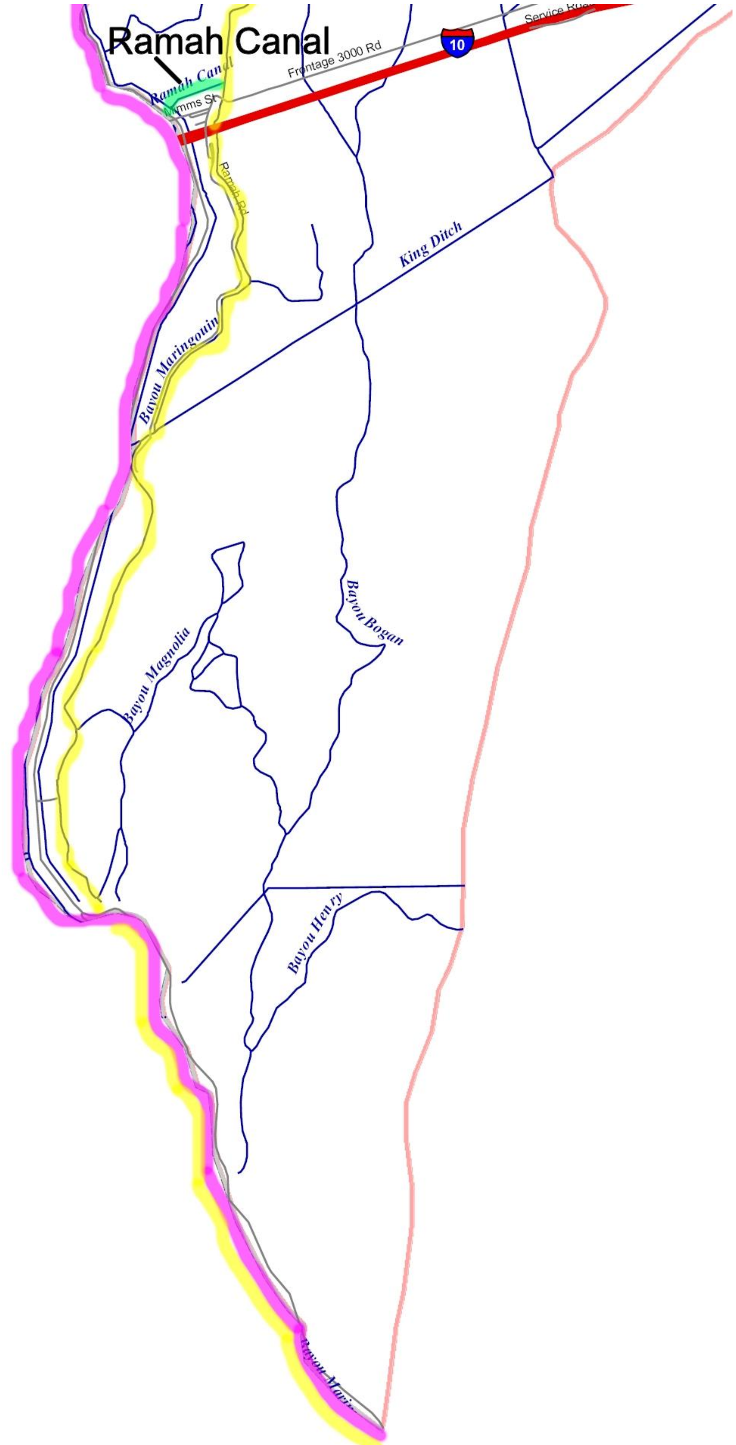


Figure 9. Unassessed portion of Bayou Maringouin (yellow), from the Ramah Canal (green) to its confluence with the borrow pits, showing how the East Atchafalaya Basin Protection Levee (pink) cuts across the bayou, forcing the bayou out of its watershed.

Figure 10. Headwaters of Bayou Maringouin.

In the past, Bayou Maringouin was probably a distributary of Bayou Grosse Tete, branching off in the town of Valverda near the intersection of Highway 77 and Highway 977. As you can see in the contour map, the two bayous appear to have been connected historically, but are now disconnected. They are separated by Highway 977, with Bayou Grosse Tete to the north and the headwaters of Bayou Maringouin to the south.

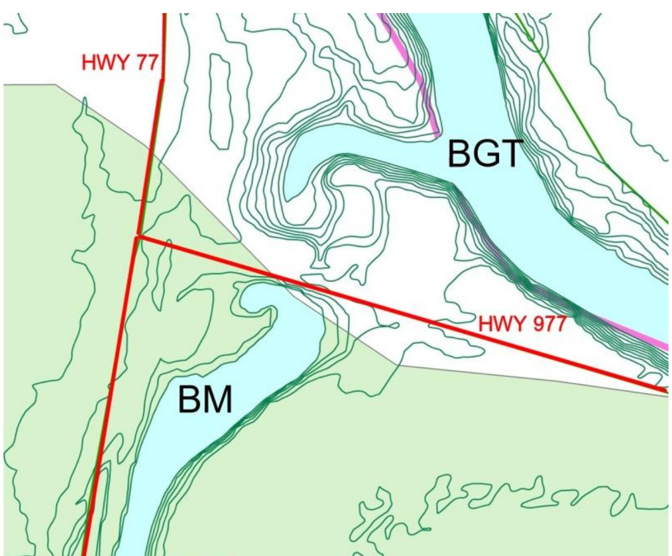


Figure 11. Contour map of Bayou Maringouin (BM) and Bayou Grosse Tete (BGT).

The only time Bayou Maringouin has a noticeable flow is when stormwater drains from its watershed during and after rainfall events. This runoff is rich in nutrients, pesticides, and sediment from the surrounding agricultural fields. These pollutants tend to accumulate in the bayou because there is not enough flowing water to remove it. (Earth Consulting Group, 2007).

Two site visits of the Bayou Maringouin watershed were conducted on April 3 and June 11, 2008. The first few miles of Bayou Maringouin have several ditches running into it which drains surrounding agricultural fields and the Livonia Hump Yard. In some areas, the land was plowed up to the edge of both Bayou Maringouin and the highway, with very little or no grass filter strip (Figure 12). At the intersection of Eldorado Road and Hwy 77, a large ditch was draining stormwater from sugarcane fields. A drastic change in the appearance of the bayou's water could be seen because of the suspended sediment flowing into the bayou from this ditch.

Figure 12. Ag field plowed to edge of Hwy 77 (foreground) and bank of Bayou Maringouin (background).

Also along Hwy 77, several farming sites were noticed to have farm equipment and barrels sitting on the ground along ditches which drained directly into the bayou (Figure 13). Herbicides, pesticides, oil, gasoline, or any other chemical could potentially leak or spill from these barrels and equipment and drain into the bayou.

Figure 13. Farming equipment along ditch that drains into Bayou Maringouin.

A weir is located in the bayou approximately 5 miles downstream from the headwaters on the north side of the Musson Lane bridge (Figure 14). Upstream of this weir, the bayou has a substantial volume of water during the summer. Without the weir, this upper section of the bayou would probably form pools of water or completely dry up during the summer. Elephant ears (*Colocasia esculenta)* are growing abundantly along the bank of the bayou, crowding out native vegetation such as the copper iris and spider lily.

Figure 14. Weir in Bayou Maringouin north of the Musson Lane bridge

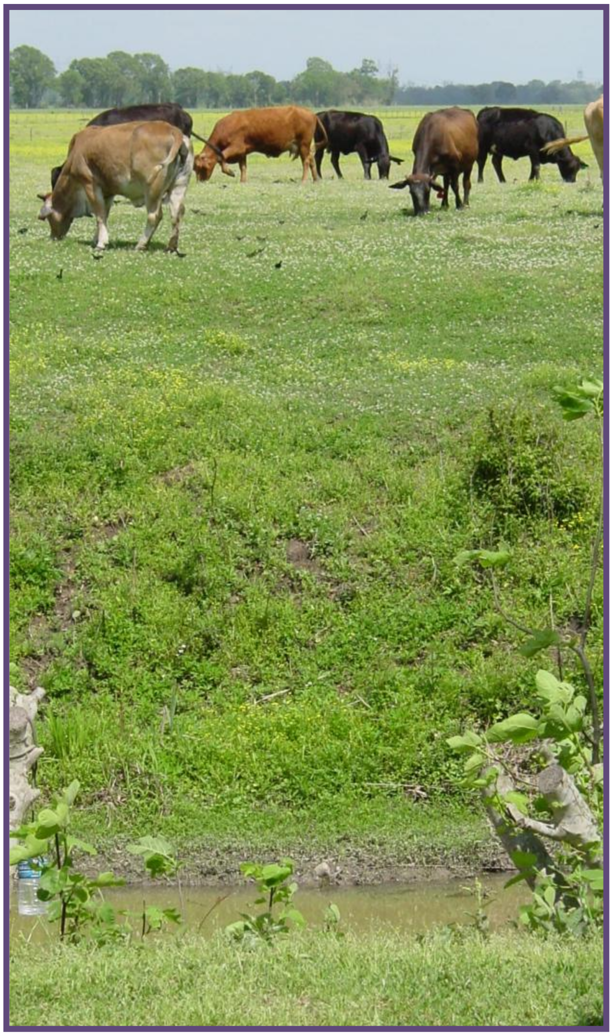


Figure 15. Unfenced cattle grazing along the bayou.

There were many old houses and churches along the bank of Bayou Maringouin on Hwy 77. Several locations were found with pipes coming out of these buildings directly into the bayou without first going through a sewage treatment system. Cattle were also grazing in fields along the bayou with no fencing to keep them out of the bayou (Figure 15). There was very little native vegetation in the bayou's riparian buffer zone, since houses, ag fields, and pastures were placed along the banks of the bayou.

Below the weir, the bayou acts like an intermittent stream (Figure 16). The amount of water in the bayou below the weir is influenced by the water elevation in the EABPL Borrow Pits. About 5 miles downstream of the weir is the Ramah Canal, where most of the water is diverted from the bayou into the EABPL Borrow Pits (Figure 17). Below the Ramah Canal, the bayou is a much smaller waterbody and appears to serve as stormwater drainage.

Figure 16. Bayou forming puddles between the weir and Ramah Canal.

Figure 17. The Ramah Canal (background) diverting most of the water in Bayou Maringouin into the EABPL Borrow Pits (foreground).

Directly below the Ramah Canal, the flow of Bayou Maringouin is believed to actually flow upstream toward the Ramah Canal and into the borrow pits. At some point, the bayou returns to flowing downstream. As Bayou Maringouin passes under I-10, the water becomes very stagnant and does not appear to be moving (Figure 18) because of the blockage created by dam-type driveways further downstream.

Figure 18. Bayou Maringouin directly south of interstate I-10.

Ramah Road follows along the side of the bayou from the Ramah Canal to King Ditch. Residencies and agricultural fields have been established on the side of the bayou opposite from Ramah Road, therefore the owners have constructed driveways to cross over the bayou in order to get to their homes and fields (Figure 19). Several of these driveways are simply an earthen dam with no culvert going underneath to allow the bayou to continue flowing.

Figure 19. One of many driveway s that act like a dam in Bayou Maringouin south of I-10, completely blocking the flow of water.

Figure 20. Resulting stagnant water trapped between two dam-type driveways.

The remnant of the bayou drains into King Ditch close to where the Ramah Road bridge crosses over King Ditch (Figure 21). King Ditch cuts across the lower part of the subsegment, which is mostly forested, and drains directly in the EABPL Borrow Pits a short distance away (Figure 22). Bayou Maringouin continues south of King Ditch through a forested area, close to the edge of the EABPL Borrow Pits. This area was not modeled in the TMDL report.

Figure 21. The remnant of Bayou Maringouin (red dashed line) escapes past the dam-type driveways and enters King Ditch.

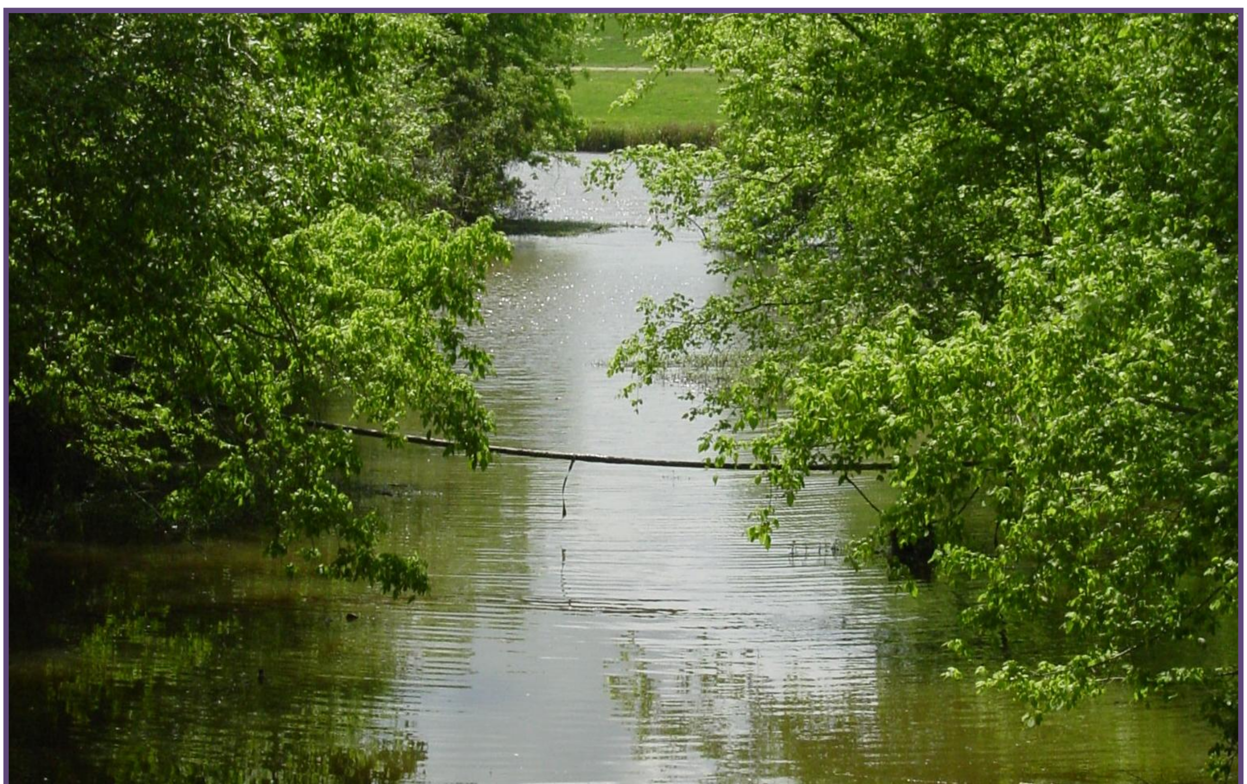


Figure 22. King Ditch empties into the EABPL Borrow Pits (background) a short distance from the Ramah Road bridge.

Figure 23. A turtle ponders his choice: stay on the Ramah Road bridge or jump into King Ditch?

There is some forestry activity occurring near the borrow pits, and also an oil well facility. Ultimately, Bayou Maringouin enters the EABPL Borrow Pits. This occurs because the East Atchafalaya Basin Protection Levee was built across Bayou Maringouin, hydrologically isolating it from the rest of the bayou that continues on the west side of the levee. This part of Bayou Maringouin is now located in the Lower Atchafalaya Basin Floodway Watershed (Subsegment 010501). Bayou Maringouin continues along the western side of the levee and eventually drains into the Intracoastal Waterway.

Figure 24. Bayou Maringouin enters the EABPL Borrow Pits near this facility.

3.0 WATER QUALITY ANALYSIS

LDEQ maintained one sampling location (0977) on Bayou Maringouin as part of the Statewide Water Quality Monitoring Network. Data was collected monthly in 2000 and 2004 from this site, which is located on the Hwy 76 bridge passing over Bayou Maringouin, 3.5 miles southwest of Rosedale, LA. A comparison of the 2000 and 2004 sampling data are presented in graphs in Section 3.1.

A water quality standard is a definite numerical criterion value or general criterion statement to enhance or maintain water quality and to provide for, and fully protect, the designated uses of a waterbody (LDEQ, 2003). The water quality standards for Bayou Maringouin are listed in Table 3.

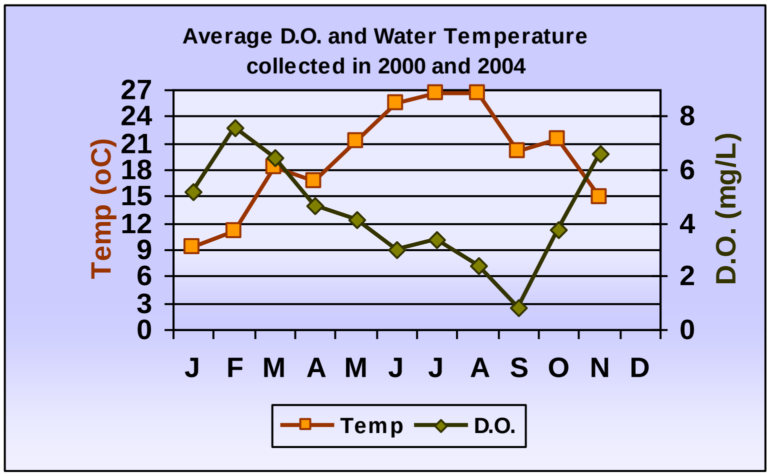
Table 3. Water Quality Standards

Water Quality Parameter	Numerical Criteria
Chlorides	25 mg/L
Sulfates	25 mg/L
Dissolved Oxygen	5.0 mg/L Dec-Feb 2.3mg/L Mar-Nov
pH	6.0 - 8.5
Bacteria concentration (log mean/100 ml)*	200 for May 1 - Oct. 31 1,000 for Nov. 1 - April 30
Temperature	32^{o}C
TDS	200

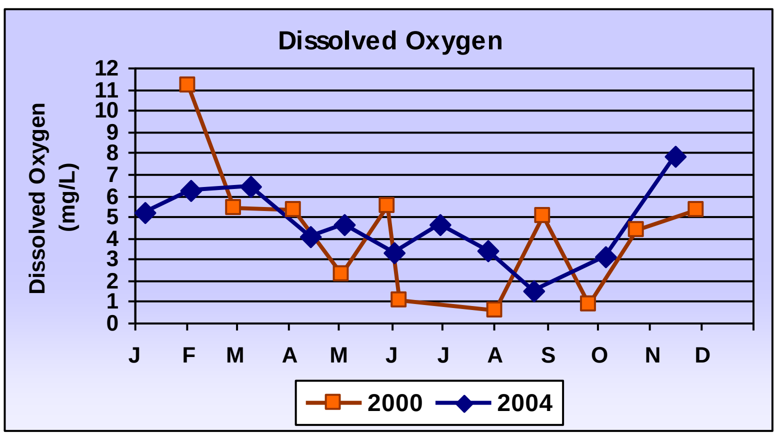
* 200 colonies/100mL maximum log mean and no more than 25% of samples exceeding 400 colonies/100mL for the period May through October; 1,000 colonies/100mL maximum log mean and no more than 25% of samples exceeding 2,000 colonies/100mL for the period November through April.

Figure 25. Shallow trash filled water remains in the bayou directly downstream of the weir.

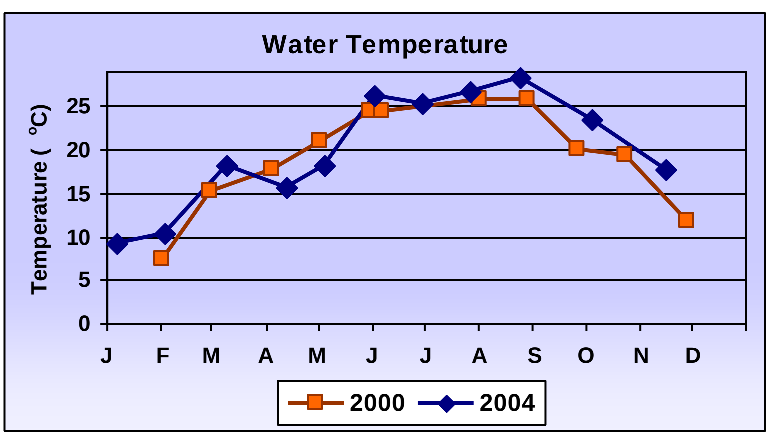
3.1. Water Quality Test Results



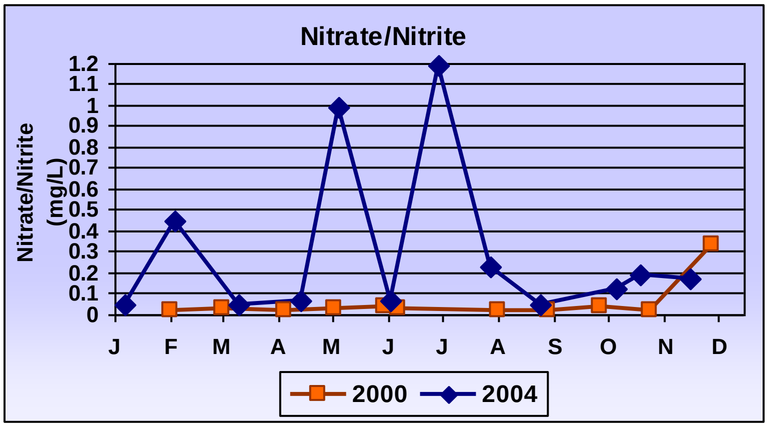
The monthly average of D.O. and water temperature data from the years 2000 and 2004 were calculated to make the graph showing the inverse relationship of D.O. and water temperature. In Bayou Maringouin, this trend was followed as the D.O. increased when the water temperature decreased. The water quality standard of 5.0 mg/l of dissolved oxygen for December – February was maintained during the winter months when the water temperature was low. The water quality standard of 2.3 mg/l of dissolved oxygen for March – November was not attainable during the hottest summer months.



For the remaining charts, the data collected from 2000 and 2004 were plotted on the same chart to enable a comparison between the years. This allows similarities of seasonal trends to be seen, and also to see if there is any improvement or deterioration of water quality between the years. Agricultural activities, such as fertilizing, irrigation, and tilling, also occur during certain times of the year, which can cause seasonal deterioration of the water quality.

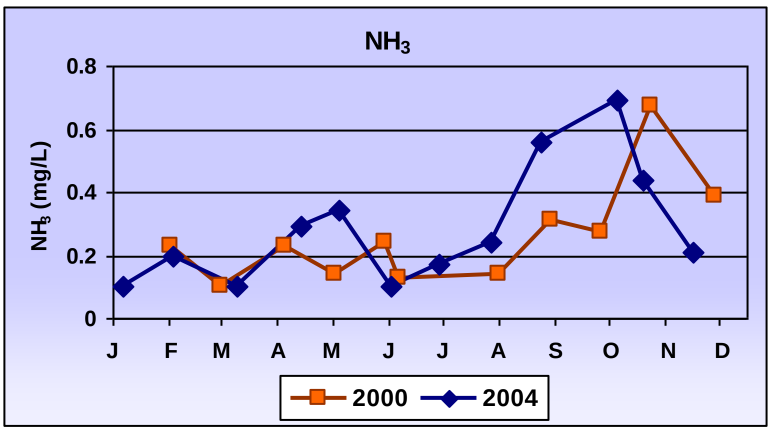


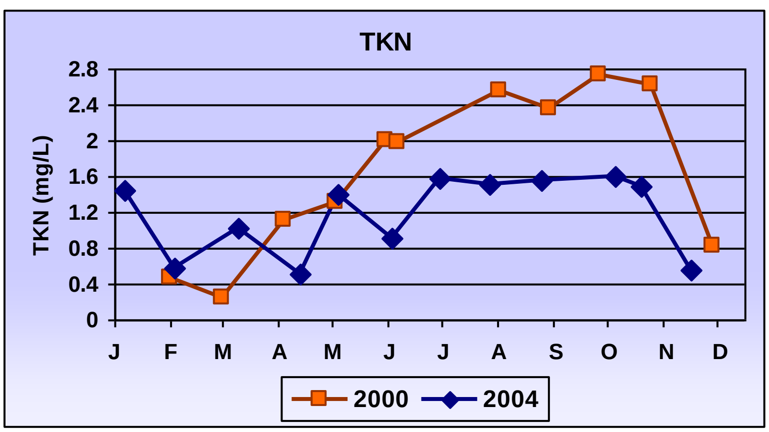
The D.O. in Bayou Maringouin appears to have improved during the summer months in 2004 compared to 2000. There does not seem to be any change in the water temperature between the years.

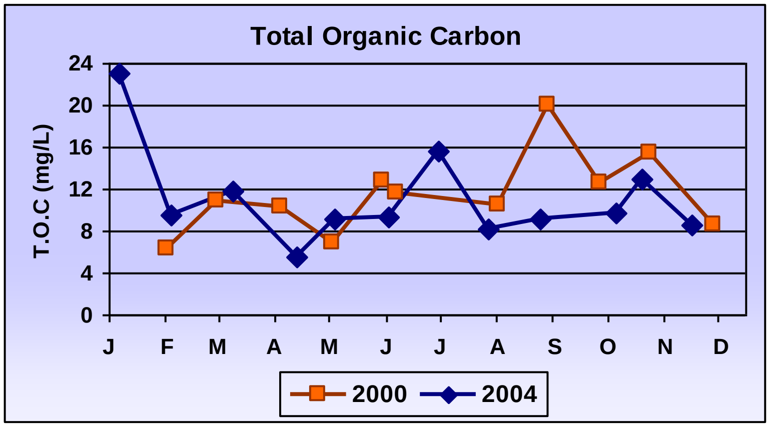


The level of Nitrate/Nitrite increased in the summer of 2004, while the levels stayed low in 2000. The level of ammonia was comparable for both years, increasing in the fall.

Total Kjeldahl Nitrogen is the amount of organic nitrogen plus ammonia. It does not include inorganic nitrogen, such as nitrate, nitrite, and ammonium. The TKN levels were higher in most of 2000 than the levels in 2004.



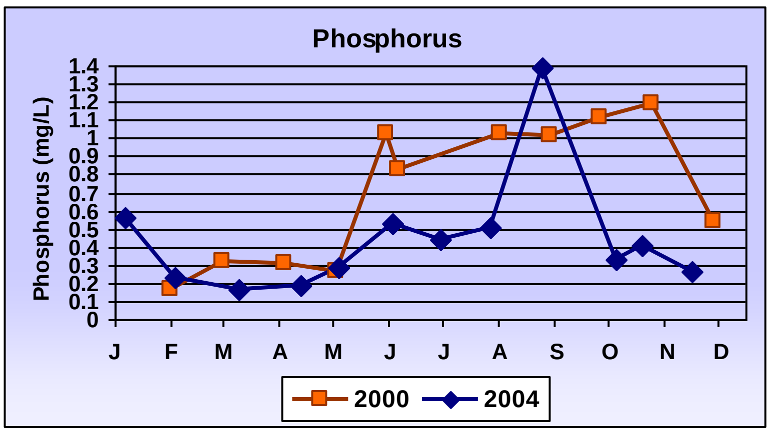


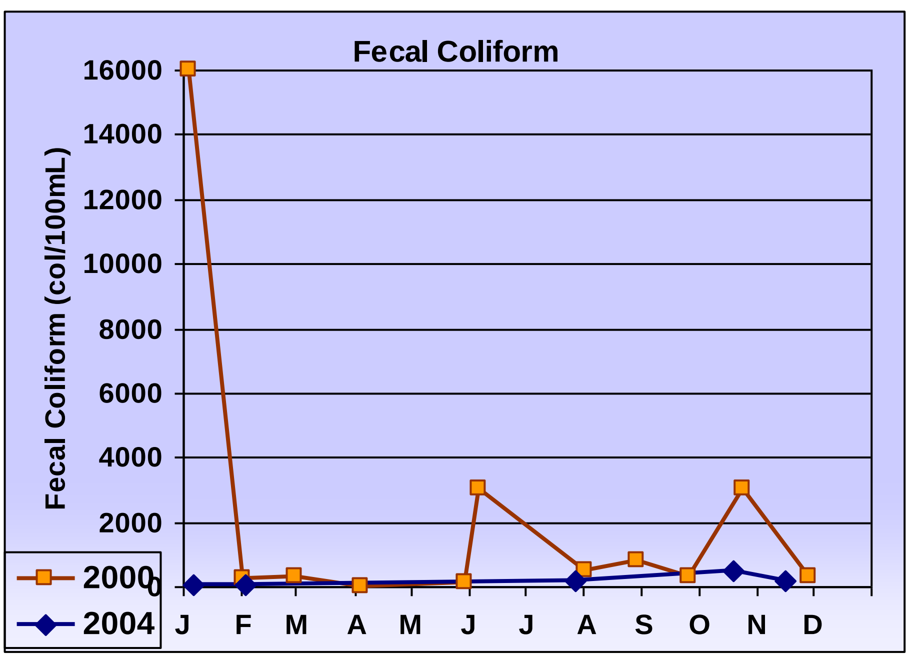


The amount of Total Organic Carbon does not seem to show any pattern of improvement between the years.

The level of Phosphorus seems to increase in the summer and fall of both 2000 and 2004.

Fecal Coliform has appears to have improved since the year 2000, with a consistently lower concentration of fecal coliform in 2004.





4.0 TMDL FINDINGS

Total Maximum Daily Loads (TMDLs) are the maximum amount of a pollutant that can be discharged into a water body without causing the water body to become impaired and/or violate state water quality standards. TMDLs are the sum of the individual Waste Load Allocations (WLAs) for point sources, Load Allocations (LAs) for nonpoint and natural background sources, and a Margin of Safety (MOS).

TMDL Allocation = WLA + LA + MOS

Water quality standards are defined based on the designated uses of the waterbody. Bayou Maringouin was listed in Louisiana's 2006 Integrated Report as not fully supporting the designated uses of Primary Contact Recreation and Fish and Wildlife Propagation. Atrazine, Fecal Coliform, and Total Dissolved Solids were ranked as High Priority for TMDL development.

At the time of the TMDL study for Bayou Maringouin, there were no known point source wastewater discharges. In order to model loading into Bayou Maringouin, the modeled section of the stream was divided into nine reaches. A description of these nine reaches is located in Table 4.

In order to meet the D.O. standard of 5 mg/L during December - February, the man-made nonpoint source loading must be reduced 90%. In order to meet the D.O. standard of 2.3 mg/L during March - November, the man-made nonpoint source loading must be reduced 100% and the natural background loading must be reduced 50%. This shows that Bayou Maringouin can not meet the standard during the summer critical season, even if every possible BMP was implemented to remove 100% of the man-made NPS loading.

Table 4. Reaches of Bayou Maringouin

Reach	Reach Description	Length (km)	Width (m)	Depth (m)
1	headwater to unnamed tributary	4.55	4.9	0.3
2	unnamed tributary	1.96	3.4	0.2
3	unnamed tributary to above weir	2.55	14.6	0.3
4	above weir to weir	1.88	11.6	0.7
5	below weir effect	0.01	3.6	0.3
6	below weir to open area	1.11	3.6	0.3
7	open area to distributary	2.7	6.1	0.5
8	distributary to wide section	4.4	7.0	0.2
9	wide section to end	0.9	12.2	0.3

The D.O. standard for Bayou Maringouin was previously 5.0mg/L. During 2009, EPA accepted a new criterion of 2.3mg/L during the summer months based on LDEQ ecoregion work. The information for Table 5 was taken from the TMDL report and reflects the reduction needed to meet the previous 5.0mg/L year round criteria.

Table 5. Total Maximum Daily Load				
	Summer		Winter	
Allocation	% Reduction Required	(Mar-Nov) (lbs/day)	% Reduction Required	(Dec-Feb) (lbs/day)
Natural Nonpoint Source LA	50	677	0	855
Manmade Nonpoint Source LA	100	0	90	51
TMDL		677		910

Table 6. Calibration Model SOD by reach		
Reach	**Reach Description**	**Calibration Model SOD (gm O_2/m^2/day)**
1	headwater to unnamed tributary	6.0
2	unnamed tributary	5.5
3	unnamed tributary to above weir	3.2
4	above weir to weir	4.2
5	below weir effect	2.0
6	below weir to open area	2.2
7	open area to distributary	2.2
8	distributary to wide section	2.3
9	wide section to end	1.8

The sediment oxygen demand (SOD) is the sum of all biological and chemical processes in the sediment that utilize oxygen. The SOD for Bayou Maringouin values were achieved through a calibration model. The SOD concentrations generally decrease from the headwaters, with the SOD being higher above the weir and lower below the weir. As the SOD increases, more oxygen is removed from the water and the DO decreases. This model shows that the DO will naturally be lower near the headwaters because the SOD is higher.

5.0 SOURCES OF NONPOINT SOURCE POLLUTION LOADING

Nonpoint source water pollution often results from many different sources in the watershed. Therefore, identifying all the types of land use, the land cover, and the distribution of each type within the watershed boundary is an important key for managing sources of NPS pollution. This type of information provides insight of where and what the sources of NPS pollutant loadings are. Land use activities such as agriculture, urban, forestry and natural systems can contribute to the pollutant loading of the waterway.

The 2006 303(d) list indicates the suspected causes and suspected sources of impairment, which are listed in Table 7. The suspected cause of impairment for Primary Contract Recreation is Fecal Coliform, which has a suspected source of on-site home septic systems. The suspected causes of impairment for Fish and Wildlife Propagation are Atrazine, Nitrate/Nitrite, Dissolved Oxygen, Total Dissolved Solids, and Total Phosphorus, all of which has a suspected source of crop production.

Table 7. 2006 303(d) List of Suspected Causes and Sources

Impaired Use	Suspected Causes of Impairment	Suspected Sources of Impairment
Fish and Wildlife Propagation	Atrazine	Irrigated and Non-irrigated Crop Production
Fish and Wildlife Propagation	Nitrate/Nitrite	Irrigated and Non-irrigated Crop Production
Fish and Wildlife Propagation	Oxygen, Dissolved	Irrigated and Non-irrigated Crop Production
Fish and Wildlife Propagation	Total Dissolved Solids	Irrigated and Non-irrigated Crop Production
Fish and Wildlife Propagation	Total Phosphorus	Irrigated and Non-irrigated Crop Production
Primary Contract Recreation	Total Fecal Coliform	On-site Treatment Systems (Septic Systems)

Figure 26. These cattle, which use the EABPL Borrow Pits as a source of water, can be a source of sediment and fecal coliform.

5.1 Agriculture

Agriculture occupies the greatest percentage of land within the Bayou Maringouin watershed. The primary agricultural crops consist of soybean, sugarcane, and pastureland, but also include wheat, cotton, bare land, and sorghum. Nutrient, pesticide, and sediment loading are associated with these activities.

5.1.1 Row Crops

Soybeans, sugarcane, wheat, cotton, and sorghum are considered "row crops". Row crops are the most common form of agricultural production in this subsegment. The common practice for preparing row crops is soil tillage. Erodible soils that have a "K-factor" (soil erodibility factor) greater than 0.4 are more susceptible to erosion when tilled or devoid of vegetation. When rainfall occurs, the soil can be easily washed into the receiving stream. This sediment runoff is often laden with fertilizers, pesticides and herbicides that can result in NPS pollutant loading into the river. If the flow rate in Bayou Maringouin is low, the NPS load can deposit and accumulate on the stream bottom. As the seasons progress, warm temperatures increase the rate that these pollutants degrade, consuming the D.O. in the receiving stream.

When fields are cultivated all the way to the edge of a stream or drainage way, there is no buffer or filtration zone for the runoff coming off the fields. Herbicides are the most common form of weed control and may be utilized as much as five times per year. They are used for weed control in the fields, along the edges of the fields, and drainage ditches. The edge of fields and drainage ways are usually kept "barren" offering almost no conservation of nutrients and soil. The bare stream banks and canals or ditches can result in increased erosion to the bayou.

Figure 27. No vegetated filter strip between row crops and ditch along Hwy 77.

5.1.2 Pastureland

Pastures require large inputs of fertilizers in order to keep a healthy food supply for the grazing animals and the production of hay. Excessive fertilizer, untimely applications, and applications near the waterways increase the probability of these nutrients getting washed into the bayou. When cattle are allowed continuous access to the stream banks, it increases the rate of bank erosion and deposition of fecal material near the stream. Cattle are attracted to these areas because of shade, water supply, and lush vegetation. Areas having high numbers of cattle that are located near a tributary or drainage are likely to contribute a significant NPS load that can affect both the D.O. and Fecal Coliform in the river.

Figure 28. Erosion around a cattle trough located near the bayou (background) can be a source of sediment.

curbs along streets are effective at trapping and retaining fine particles. The build-up of pollutants gets washed off quickly during storms and is efficiently delivered to the receiving waterbody. In addition, as most other source areas are "upstream" from streets and their gutters, pollutants delivered from sidewalks, driveways, rooftops, and lawns ultimately pass through street gutters on their way to the storm drain. Lawns contribute the highest amounts of nitrogen and fecal coliform. The runoff from parking lots is contaminated with oil, grease, and metals.

5.2 Urban

There are very little urbanized areas in this watershed. Most residences are in the small town of Maringouin, which has a population of 1,262 people in the 2000 Census. The town is not growing fast; the population was 1,149 in the 1990 Census. Sources of NPS urban pollutants include lawns, driveways, rooftops, parking lots, and streets. Urban areas have higher amounts of impervious surfaces, which affect water quality and water quantity. Commercial parking lots and streets are the largest contributors to runoff. In places where little infiltration occurs, nearly all rainfall becomes runoff.

Streets produce some of the highest concentrations of phosphorus, suspended solids, bacteria, several metals, and disproportionately higher amounts of total runoff from the watershed. Streets typically contribute four to eight times the pollutant load of all other sources. The reason is that

Figure 29. Fresh grave sites on the bank of Bayou Maringouin can be a source of sediment.

5.3 Home Sewage

Failing individual septic systems, whether from lack of maintenance, improper installation, improper design, or a combination thereof is a key source of NPS pollutants. This is a classic case of "out of sight, out of mind". Failing septic systems result in discharges of untreated wastewater containing harmful bacteria and organic compounds. The pollutants of concern that are associated with this type of waste are fecal coliform, nitrogen compounds, phosphorus, and organic materials. Local drainage ditches are where most of the untreated wastewater tends to accumulate.

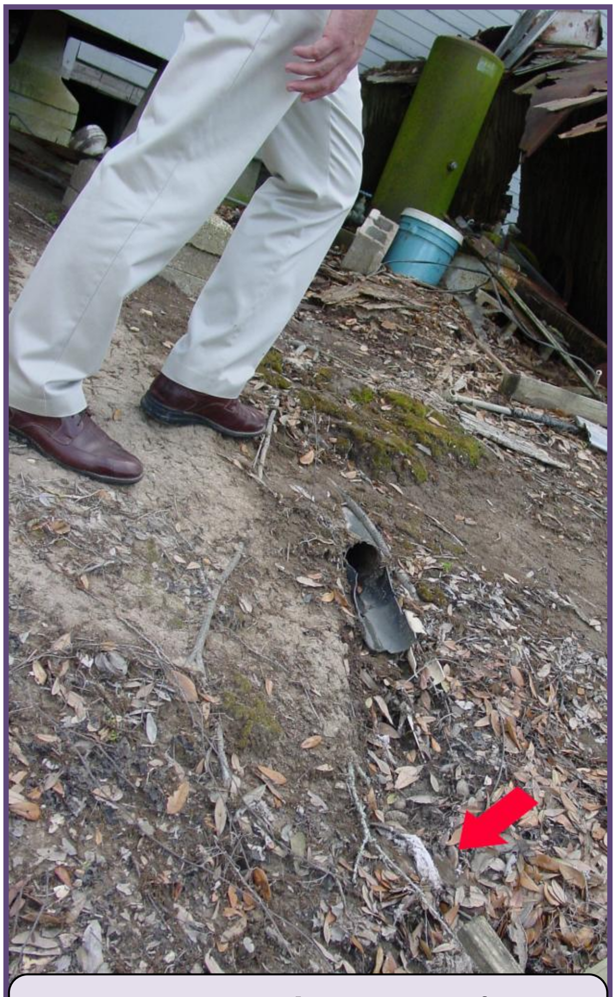


Figure30. Suspected sewage pipe from a church with tissue (red arrow) draining directly onto the bank of the bayou.

Along the banks of Bayou Maringouin, several locations (homes and churches) were found which had raw sewage pipes draining directly into the bayou from the building. The wastewater was not going through a septic treatment system. There was bathroom tissue on the ground at the opening of the pipes.

Without a sustained flow of water, build-up of excess nutrients and organic matter quickly deplete dissolved oxygen levels, often resulting in anaerobic/anoxic conditions. Most of the "beneficial" microorganisms, including the natural predators of harmful bacteria require oxygen in order to survive. However, E. coli can survive with or without oxygen in untreated septic discharges.

Each time a rain event occurs in the rural areas of the watershed, the accumulated deposits of untreated wastewater from failing home septic systems get washed into the bayou. Throughout the watershed, a network of drainage ditches exists which receive and drain runoff to Bayou Maringouin. Any ditches that are stripped of vegetation offer little filtration and absorption, reduced denitrification rates, higher temperatures, low oxygen levels, and fewer habitats for natural predators of bacteria.

5.4 Rail Yard Activity

The Union Pacific Railroad Livonia Hump Yard is located less than a mile from the headwaters of Bayou Maringouin. There is the potential of diesel fuel to leak or spill from the trains. It has been proven that diesel fuel spilled in rail yards can soak into the ground and contaminate the ground water. Diesel fumes and soot (diesel particulate matter) also contaminate the air. Drainage from this rail yard could possibly contain chemicals associated with the use of diesel fuel and diesel engines, such as chlorinated ethylenes, benzene, toluene, ethyl-benzene, and xylene (Hirl, 1998).

Figure 31. Drainage ditch from the Livonia Hump Yard clogged with debris.

5.5 Forestry

Deciduous Forest Land and Forested Wetland make up about 30% of the Bayou Maringouin Watershed. Most of this is located below I-10, which was not modeled in the TMDL report. There is some silviculture activity occurring in the watershed, which appears as a checkerboard pattern in satellite photos (Figure 32). This forest removal is occurring where Bayou Maringouin is cut off by the EABPL and forced to join the borrow pits. These borrow pits eventually flow into subsegment 120107, the Upper Grand River and Lower Flat River Watershed.

Areas of harvested forest are shown as green and yellow squares in Figure 33. The areas indicated on the map represent those areas harvested that were determined using the technique as described in the report titled *Data and Procedures for Delineating Activities Related to Coastal Wetland Forest Removal in South Louisiana from 2000 through 2006*. Some timber harvesting (especially thinning practices) may have been missed due to the conservative nature of the technique.

Figure 32. Satellite image of forestry activity in Bayou Maringouin Watershed.

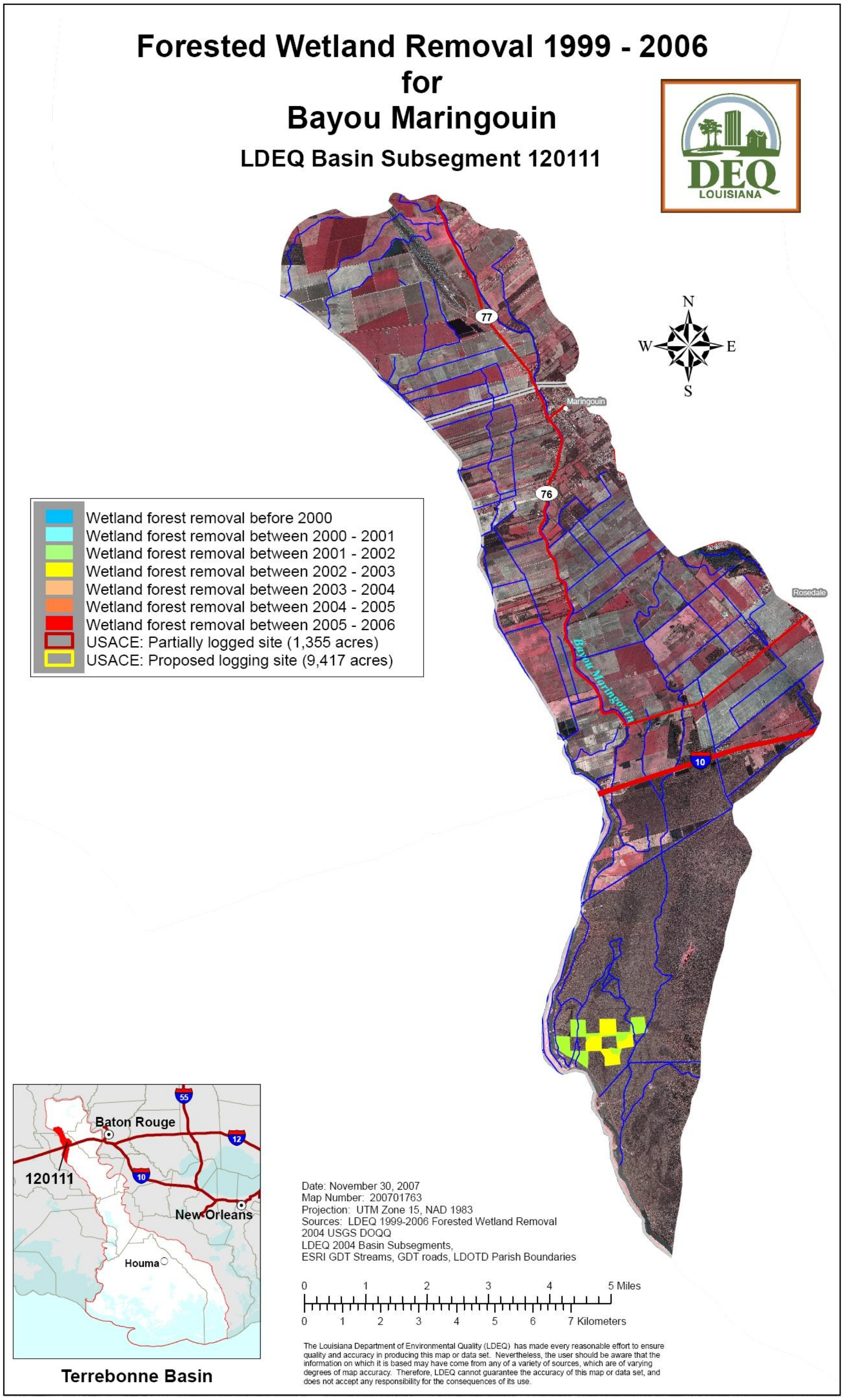


Figure 33. Areas of forest removal in Bayou Maringouin Watershed.

5.6 Hydromodification

Hydromodification causes streams to become unstable and lose their function. There are at least four large man-made straight canals north of I-10 that channel runoff from agricultural fields directly into Bayou Maringouin. These canals are interconnected to a larger network of drainage ditches from agriculture fields. The Ramah Canal is a man-made ditch north of I-10 that drains most of Bayou Maringouin's water directly into the EABPL borrow pits. South of I-10, the man-made King Ditch cuts across Bayou Maringouin and drains into the EABPL borrow pits. This ditch collects runoff from both agricultural land and forest land.

Figure 34. Trash accumulating beneath the weir on the bayou.

When channels get straightened, stream banks start down-cutting. Down-cutting is a process of bank erosion that causes the banks to progress towards a more natural slope seeking access to the river's flood plain. Stream banks become highly incised or steeped, causing a sloughing of sediment into the stream. This process can cause a chronic NPS sediment load into the bayou. Hydromodification causes streams and/or rivers to become unstable and lose their function. The function of a river is to transport sediment and water in a manner without degrading the stream banks.

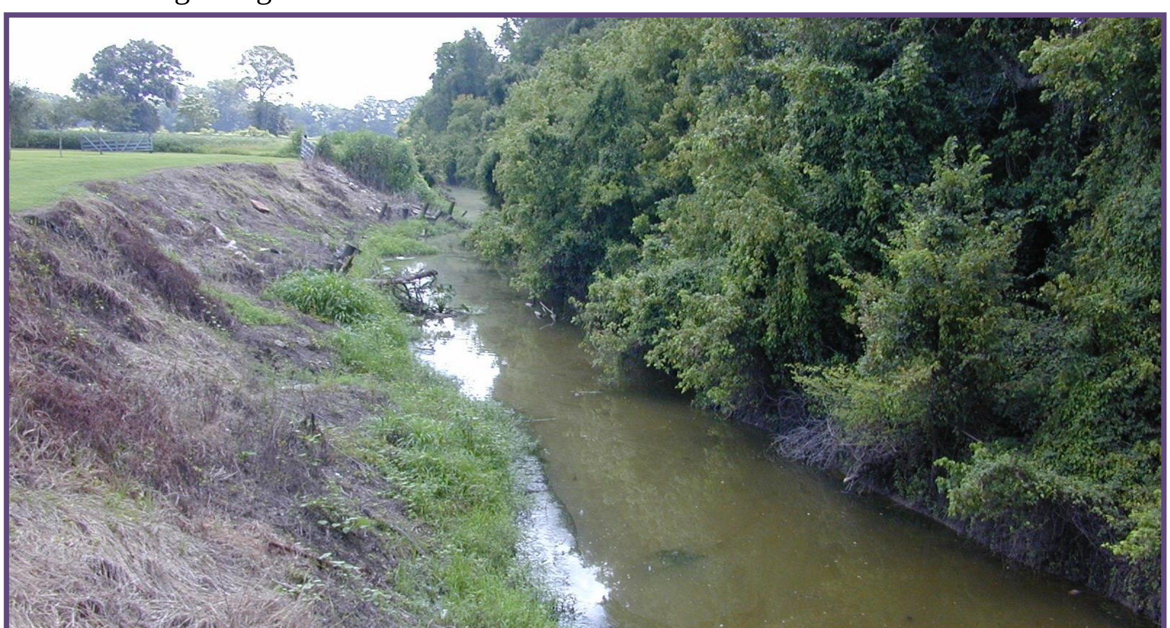


Figure 35. Eroding stream bank along Bayou Maringouin. Lush vegetation on right bank, and vegetation killed on left bank, possibly by spraying herbicide.

6.0 NONPOINT SOURCE POLLUTION SOLUTIONS

Implementation of best management practices in the watershed constitutes the building blocks of watershed protection and improving water quality. Since the watershed encompasses a narrow range of land uses, the description of BMPs is divided into categories. Each different category contains site-specific BMPs that minimize a particular source of NPS pollution. BMPs can include structural controls and/or nonstructural controls. Structural controls are those, whether natural or man-made, that can filter, detain, or reroute contaminants carried in surface runoff. Nonstructural controls utilize techniques such as land-use planning, land-use regulations, and land ownership to eliminate or minimize sources generating a NPS loading. Some of the most important aspects of successfully implementing BMPs are public awareness, education, and participation. Reduction and prevention of NPS pollution in the watershed will involve a concerted effort from all the stakeholders in it.

6.1 Agricultural BMPs

Agricultural BMPs are generally associated with the management of soil, nutrients, pesticides, and water, which are known to be a contributing source of NPS pollutant loading. If fertilizers, herbicides, and pesticides remained in the fields, the NPS load would be less. Therefore, sites should be managed in such a way that the surface runoff rate is not excessive and that it is not contaminated. Reducing NPS loading from agricultural fields will require a concerted effort between all the associated federal, state, and local agencies. Proper management will require agriculture programs which provide environmental education as well as effective production strategies. Agriculture programs should be designed to foster a sense of conservation stewardship for each type of agricultural producer. Examples of these programs are the Louisiana Master Logger Program and the Louisiana Master Farmer Program.

For successful agricultural programs to continue in the watershed, all the cooperating entities will need to participate. The key partners (i.e. NRCS, SWCD, LDAF, LCES, LDNR, and FSA) are the federal, state, and local agencies, which provide funding through cost-share assistance, incentives, expertise through technical assistance, and education through information outreach programs to the farmers. A complete list of agriculture BMPs is provided by the NRCS in the “Technical Guide Handbook”. The handbook includes a description of each BMP and their recommended uses. LDEQ has a comprehensive list of BMPs for controlling NPS pollutant loads, programmatic goals and activities, and future objectives and milestones included in the State of Louisiana Water Quality Management Plan, Volume 6, Louisiana’s Nonpoint Source Management, 2000.

Table 8. Cropland Best Management Practices Effectiveness			
BMP	**Targeted Pollutant in Surface Water**	**Effectiveness of BMP**	**Crops**
Mulch Till	Sediment	slight	1,2,4-6
No Till	Sediment	moderate	1,2,4-6
Ridge Till	Sediment	slight-moderate	1-3,5,6
Contour farming	Sediment	moderate	1,2,5,6
Grassed waterway	Sediment	slight-moderate	1-6
Residue Mgt.,Seasonal	Sediment	slight	1-6
Grade stab strut.	Sediment	slight-moderate	1-6
Cons. crop. rot.	Sediment	slight-moderate	1-6
Irrig.Water mgt.	Sediment	moderate	1-6
Tailwater rec.	Sediment	slight	1-6
Struct. water cont.	Sediment	slight	1-6
Water & sed. basin	Sediment	moderate-substantial	1,2,5,6
Sediment basin	Sediment	substantial	1,2,5,6
Irrig. leveling	Sediment	slight	1-6
Field border	Sediment	slight-moderate	1,2,5,6*
Cover crop	Sediment	slight-moderate	1-6
Deep Tillage	Sediment	slight-moderate	1-6
Filter strips/buffers	Sediment	substantial	1,2,4-6*
Diversion	Sediment	medium	1,2,5,6
Pest management	Soluble Pesticide	Substantial	1-6
Irrig.Water mgt.	Soluble Pesticide	slight	1-6
Tailwater rec.	Soluble Pesticide	slight	1-6
Land leveling	Soluble Pesticide	slight	1-6
Irrig. system	Soluble Pesticide	slight	1-6
Field border	Soluble Pesticide	slight	1-6**
Cover crop	Soluble Pesticide	slight	1-6
Deep Tillage	Soluble Pesticide	slight	1-6
Cons. crop. rot.	Soluble Pesticide	slight	1-6
Mulch till	Soluble Pesticide	moderate	1,2,4-6
No till	Soluble Pesticide	moderate	1,2,4-6
Ridge Till	Soluble Pesticide	moderate	1-6
Crop residue,Seasonal	Soluble Pesticide	slight	1-6
Water & sed. basin	Soluble Pesticide	slight	1,2,5,6
Terrace	Soluble Pesticide	slight	1,2,5,6
Sediment basin	Soluble Pesticide	slight	1,2,5,6
Filter strip/buffers	Soluble Pesticide	slight	1-6**
Contour farming	Soluble Pesticide	slight	1,2,5,6
Stripcropping	Soluble Pesticide	slight	1,2,5,6
Diversion	Soluble Pesticide	slight	1,2,5,6
Grassed waterway	Soluble Pesticide	slight	1-6 ***
Pest management	Adsorbed Pesticide	Substantial	1-6
Irrig.Water mgt.	Adsorbed Pesticide	substantial	1-6
Tailwater rec.	Adsorbed Pesticide	moderate	1-6
Land leveling	Adsorbed Pesticide	moderate	1-6

Irrig. system	Adsorbed Pesticide	substantial	1-6
Field border	Adsorbed Pesticide	moderate	1-6**
Cover crop	Adsorbed Pesticide	moderate	1-6
Deep Tillage	Adsorbed Pesticide	substantial	1-6
Cons. crop. rot.	Adsorbed Pesticide	moderate	1-6
Mulch till	Adsorbed Pesticide	substantial	1,2,4-6
No till	Adsorbed Pesticide	substantial	1,2,4-6
Ridge Till	Adsorbed Pesticide	substantial	1-6
Crop residue,Seasonal	Adsorbed Pesticide	moderate	1-6
Water & sed. basin	Adsorbed Pesticide	moderate	1,2,5,6
Terrace	Adsorbed Pesticide	substantial	1,2,5,6
Sediment basin	Adsorbed Pesticide	moderate	1,2,5,6
Filter strip/buffers	Adsorbed Pesticide	substantial	1-6**
Contour farming	Adsorbed Pesticide	moderate	1,2,5,6
Stripcropping	Adsorbed Pesticide	moderate	1,2,5,6
Diversion	Adsorbed Pesticide	slight	1,2,5,6
Grassed waterway	Adsorbed Pesticide	moderate	1-6 ***
Nutrient Mgt.	Soluble Nutrients	substantial	1-6
Waste utilization	Soluble Nutrients	slight	1-6
Irrig.Water mgt.	Soluble Nutrients	slight	1-6
Tailwater rec.	Soluble Nutrients	slight	1-6
Land leveling	Soluble Nutrients	slight	1-6
Irrig. system	Soluble Nutrients	slight	1-6
Field border	Soluble Nutrients	slight	1-6*
Cover crop	Soluble Nutrients	slight	1-6
Deep tillage	Soluble Nutrients	slight	1-6
Cons. crop. rot.	Soluble Nutrients	slight	1-6
Mulch till	Soluble Nutrients	slight	1,2,4-6
No till	Soluble Nutrients	slight	1,2,4-6
Ridge till	Soluble Nutrients	slight	1-6
Crop residue,Seasonal	Soluble Nutrients	slight	1-6
Water & sed. basin	Soluble Nutrients	slight	1,2,5,6
Terrace	Soluble Nutrients	slight	1,2,5,6
Sediment basin	Soluble Nutrients	substantial	1,2,5,6
Filter strips/buffers	Soluble Nutrients	substantial	1-6*
Contour farming	Soluble Nutrients	slight	1,2,5,6
Stripcropping	Soluble Nutrients	slight	1,2,5,6
Grassed waterway	Soluble Nutrients	slight	1-6 ***
Waste utilization	Adsorbed Nutrients	moderate	1-6
Irrig.Water mgt.	Adsorbed Nutrients	substantial	1-6
Tailwater rec.	Adsorbed Nutrients	moderate	1-6
Land leveling	Adsorbed Nutrients	moderate	1-6
Irrig. system	Adsorbed Nutrients	substantial	1-6
Field border	Adsorbed Nutrients	moderate	1-6*
Cover crop	Adsorbed Nutrients	moderate	1-6
Deep tillage	Adsorbed Nutrients	substantial	1-6
Cons. crop. rot.	Adsorbed Nutrients	moderate	1-6
Mulch till	Adsorbed Nutrients	moderate	1,2,4-6
No till	Adsorbed Nutrients	slight	1,2,4-6
Ridge till	Adsorbed Nutrients	slight	1-6

Crop residue Seasonal	Adsorbed Nutrients	slight	1-6
Water & sed. basin	Adsorbed Nutrients	moderate	1,2,5,6
Terrace	Adsorbed Nutrients	moderate	1,2,5,6
Contour farming	Adsorbed Nutrients	substantial	1,2,5,6
Stripcropping	Adsorbed Nutrients	substantial	1,2,5,6
Grassed waterway	Adsorbed Nutrients	moderate	1-6 ***
Waste utilization	Oxygen Demand	slight	1-6
Field border	Oxygen Demand	mod	1,2,5,6*
Filter strips/buffers	Oxygen Demand	sub	1,2,5,6*
Terrace	Oxygen Demand	moderate	1,2,5,6
Contour farming	Oxygen Demand	mod	1,2,5,6
Stripcropping	Oxygen Demand	mod	1,2,5,6
Water & sed. basin	Oxygen Demand	mod	1,2,5,6
Sediment basin	Oxygen Demand	sub	1,2,5,6
Diversion	Oxygen Demand	neutral	1,2,5,6
Irrig Water mgt.	Oxygen Demand	slight	1-6
Irrig. system	Oxygen Demand	slight	1-6
Deep tillage	Oxygen Demand	slight	1-6
Waste utilization	Bacteria	neutral	1-6
Field border	Bacteria	slight	1,2,5,6*
Filter strips/buffers	Bacteria	slight	1,2,5,6*
Terrace	Bacteria	moderate	1,2,5,6
Contour farming	Bacteria	slight	1,2,5,6
Stripcropping	Bacteria	slight	1,2,5,6
Water & sed. basin	Bacteria	slight	1,2,5,6
Sediment basin	Bacteria	mod	1,2,5,6
Diversion	Bacteria	slight	1,2,5,6
Irrig Water mgt.	Bacteria	substantial	1-6
Irrig. system	Bacteria	slight	1-6
Deep tillage	Bacteria	slight	1-6

1 = cotton, 2 = soybeans, 3 = sugarcane, 4 = rice, 5 = corn, 6 = truck crops
* Fields not artificially drained.
**Fields not artificially drained.
*** Chemical maintenance of vegetation may adversely affect the quality of runoff water.

Figure 36. Agricultural field plowed to the edge of the ditch along Hwy 77.

6.1.1 Row crop BMPs

Since row crops occupy the largest portion of agricultural land use in the watershed, implementation of row crop BMPs should reduce a significant amount of the NPS loading. Row crop agriculture involves tillage practices that pulverize the soil in order to create a heaping row for planting crops. BMPs for this type of land use should be focused on the management of soil, water, pesticides, and nutrients. These constituents are known to cause NPS pollutant loads, if they are washed into the receiving stream by surface runoff. Controlling the NPS pollutant loading requires implementing BMPs that reduce the amount of surface runoff and the amount of NPS pollutants in it. In addition to implementing BMPs, the producer should develop and utilize pollution prevention strategies such as spill prevention practices for sites where the agro chemicals and fertilizer are stored, off loaded, or prepared for field application.

Multi-Use Drainage

A general type of BMP that can be very cost effective for all types of agriculture production, and serving as a passive form of treatment for the runoff draining from the fields, is open drainage ditches covered with native grasses and/or wetland plants. This type of practice often occurs naturally in the Gulf Coastal Region, serving as a form of surface filtration for surface waters en route to the Gulf of Mexico. Most agricultural field sites already maintain an open ditch system, designed to remove surface runoff from the fields and prevent flooding. When utilizing this BMP, the open drainage ditch serves not only to prevent flooding and remove surface runoff from the site, but also as a form of biological treatment of the waters draining from the site. This practice is similar to the BMP referred to as a grassed waterway, but focuses on use of native vegetation and wetland plants, where possible. It is widely known that the roots of wetland plants provide an oxygen rich environment where there are high densities of microbes, which biologically degrade nutrients and pollutants into harmless substances.

Figure 37. A vegetated ditch drains row crops.

Other benefits of utilizing this BMP include:

1) Minimizes soil loss resulting from eroding ditch banks,
2) Ditch serves as a "capture mechanism" for soil loss from the field, which can be recovered and redistributed by the farmer as necessary,
3) Wetland plants impede flow less than weeds due to their nature to contour or lay down with the water flow and due to the sub-surface flows occurring

through their highly permeable roots unlike weeds or grasses,

4) Reduced herbicide use because the native vegetation, once established, will out-compete and eliminate future weed growth,
5) Compliments local environment (Gulf Coast Region), supports a healthy aquatic landscape and increases aesthetics.

Naturalization of Land Unsuitable for Agriculture

Another consideration is to convert the marginal land in the field that has low productivity, such as naturally wet areas and areas near the edge of streams, back into the native landscape. Typically, excess resources and finances are wasted on these types of areas only to produce a below average yield. The time, manpower, supplies, and capital that was used on the marginal areas could be focused on the quality management of the productive lands. When marginal areas are converted back to their natural state, they will serve a greater value to the landowner and the watershed. The land can serve as a buffer offsetting the effects of production activities, as a hunting lease, for future timber harvest, a wildlife habitat, and/or recreation.

Conservation Tillage

Conservation tillage practices such as stale seed bed and no till have proven to be successful in producing less NPS loading. These practices utilize bulk organic matter remaining from winter crops as a sponge, while planting directly into it. Leaving bulk material in the fields after harvest is known as residue management, which has a positive effect on surface water quality. Planting soybeans directly into the soil without tillage is another conservation practice. Conservation tillages are designed to reduce the amounts of runoff and rates of flow. In return, there is more sediment, nutrients, and pesticides/herbicides remaining in the fields for growth each growing season. This saves money and reduces the NPS loading.

LDEQ funded a project in the Bayou Wikoff sub-watershed of Bayou Plaquemine Brule in the Mermentau Basin. The purpose of this project was to gather information on the effectiveness of best management practices in reducing nonpoint source pollutants from sugarcane fields. The results indicated that when mulch residue was left on the field after harvest, that total solids could be reduced by 34%, suspended solids by 26%, turbidity by 60% and phosphorus by 8% compared to fields where the sugarcane residue was burned. Therefore, leaving the mulch on the field after harvest will reduce the amount of nonpoint source loadings into the bayou.

Vegetated Filter Strip

A general and cost effective practice is to maintain a strip of vegetation around the perimeter of each field site and within the field ditches. This practice is similar to the BMP referred to as vegetative filter strip or field border and the grassed waterway, except use of native vegetation for cover is encouraged. If the grassed waterway is covered with wetland plants and/or native grasses, the drainage way can also function as a form of passive biological treatment, which can also reduce NPS loads. The amount of herbicides used should be less, saving costs.

Field sites having a high population density should consider field-rotations to allow for re-establishment of vegetation cover and maintenance. Sites with a healthy cover of vegetation have less runoff. If a field site's size is not adequate for field-rotations, ponds could be constructed to capture excess surface runoff from the site. The surface runoff could be routed through a vegetated field ditch, which would work in conjuction with the pond to reduce NPS loading from leaving the site.

These practices help to keep the sediment, nutrients, and fecal coliform at the field site.

The land in and along field ditches, wetlands, and stream banks is very important for preventing sediment, nutrients, and organic matter from entering bodies of water. This area of land between wet and upland landscapes is referred as the "riparian buffer zone." Protecting these areas from continuous livestock grazing is an effective BMP for preventing NPS pollutant loading. Often livestock access these areas for a source of water, shade, and lush vegetation. When livestock are restricted from the riparian buffer zone, the producer should make accommodations to provide an alternative source of water, shade, and food.

Optical Sensors

Recent technological advances in agriculture have enabled the use of optical sensors, which allow varying amounts of fertilizer to be applied to crops instead of one set amount for the entire field. Optical sensors can be mounted on tractors or other fertilizer application systems to deliver precise amounts of fertilizer to plants. By using infrared and near infrared light to assess the health of the crops, an optical sensor can instantly calculate the amount of fertilizer needed to obtain a maximum yield of crop. Since healthy plants absorb more infrared light during photosynthesis and reflect more near infrared light than unhealthy plants, the optical sensors can determine which plants need more fertilizer.

By using these sensors, the over-application of fertilizer can be drastically cut back and less fertilizer will be wasted. It also works equally well at night, when there is less wind drift. In addition to saving money, there will be less fertilizer available in the field to make its way into the runoff. It can also be used to apply herbicide to living weeds, and not waste spray on bare ground or dead weeds.

Precision Land Leveling

Precision land leveling involves cutting or filling a field in order to create a constant slope between 0 to 0.2%. Global positioning systems (GPS) and/or laser-guided instruments are used to create the desired slope. A levee is constructed around the field so that the desired amount of water on the field can be maintained. By keeping the field flooded until ready for planting, there is an increase in nutrient availability and weed control. The water release is controlled while the fields are drained, thus decreasing sediment loading.

All of the BMPs mentioned above are very cost effective and prevent NPS loading. In addition to implementing BMPs, the producer should develop and utilize pollution prevention strategies such as spill prevention practices for sites where the agro chemicals and fertilizer are stored, off loaded, or prepared for field application.

Field Stripcropping

Field stripcropping is the practice of growing crops in a systematic arrangement of strips. The crops are arranged so that a strip of grass or small grains is alternated with a strip of row crops. The strips should be approximately the same width. The strips of grass slow runoff, increase the infiltration of water into the soil, and trap sediment moving from the crop strips.

Pipe Drop Structures

As water flows downhill, it will make natural channels that can become large unsightly gullies. This can be prevented by installing pipe drop structures, which safely delivers the water at a lower level while preventing massive erosion.

6.1.2 Pastureland BMPs

Pastureland occupies the third largest portion of agricultural land use in the watershed. Pastureland BMPs should focus on measures to control the amount of sediment, nutrients, and fecal coliform in the surface waters draining from the field site. Knowledge of the field sites' delineation and drainage pattern can be helpful when identifying pathways and potential sources of NPS pollutants. During or shortly after a rainfall event is the best time to make this assessment. With this information, the operator can work strategically to implement the BMPs that prevent pollutant sources and/or prevent them from leaving the site.

Vegetative Filter Strip

A general and cost effective practice is to maintain a strip of vegetation around the perimeter of each field site and within the field ditches. The use of native vegetation for cover is encouraged for vegetative filter strips and grassed waterways. If the grassed waterway is covered with wetland plants and/or native grasses, the drainage way can also function as a form of passive biological treatment, which can also reduce NPS loads. The amount of herbicides used should be less, saving costs.

Prescribed Grazing

Field sites having a high population of livestock should consider field rotations to allow for the regrowth of vegetation. Sites with a healthy cover of vegetation have less runoff. If a field site's size is not adequate for field-rotations, ponds could be constructed to capture excess surface runoff from the site. The surface runoff could be routed through a vegetated field ditch, which would work in conjunction with the pond to reduce NPS loading from leaving the site. These practices help to keep the sediment, nutrients, and fecal coliform at the field site.

LDEQ funded a project in the Bayou Wikoff sub-watershed of Bayou Plaquemine Brule in the Mermentau Basin. The purpose of this project was to gather information on the effectiveness of best management practices in reducing nonpoint source pollutants from pastures. The results indicated that with the use of rotational grazing, the suspended solids could be reduced by 65% and turbidity by 58%, total phosphorus by 49% and dissolved phosphorus by 40%.

Riparian Buffer Zone Protection

Protecting the riparian zone along Bayou Maringouin, as well as the ditches that run into the bayou, is necessary to prevent sediment, nutrients, and organic matter from entering the bayou. Livestock frequently access these areas to obtain water, shade, and lush vegetation. The hoof traffic along the stream banks can cause serious sediment and fecal coliform loading. Fencing can be used to protect the riparian zone from the damage caused by livestock. When livestock are restricted from the riparian buffer zone, the producer should make accommodations to provide an alternative source of water, shade, and food. Water troughs should be placed on top of a concrete pad to prevent further erosion problems from occurring.

Figure 38. This fencing keeps cattle out of the bayou along Overton Road.

Table 9. Pastureland Best Management Practices Effectiveness		
BMP	**Targeted Pollutant in Surface Water**	**Effectiveness of BMP**
Pasture & hayland planting	Sediment	substantial
Irrigation water management	Sediment	substantial
Critical area planting	Sediment	substantial
Fencing to distribute grazing	Sediment	neutral
Prescribed Grazing	Sediment	substantial
Mechanical Forage Harvest	Sediment	moderate
Irrigation water conveyance	Sediment	moderate
Appropriate irrigation system	Sediment	moderate
Filter strip/buffer	Sediment	moderate
Pond to distribute grazing	Sediment	slight-substantial
Spring development to distribute grazing	Sediment	slight
Brush management	Sediment	slight
Nutrient management	Nutrients	substantial
Waste Utilization	Nutrients	substantial
Irrigation water management	Nutrients	substantial
Pasture & hayland planting	Nutrients	substantial
Use Exclusion to exclude livestock from streams	Nutrients	neutral
Pond	Nutrients	slight-moderate
Buffers	Nutrients	slight-substantial
Fencing to distribute grazing	Nutrients	neutral
Prescribed Grazing	Nutrients	moderate
Forage harvest mgt.	Nutrients	slight-moderate
Pasture & hayland planting	Pesticides	substantial
Irrigation water management	Pesticides	substantial
Prescribed grazing	Pesticides	moderate
Forage harvest management	Pesticides	slight-moderate
Filter strips/buffers	Pesticides	moderate
Pest Management	Pesticides	substantial
Waste utilization	Oxygen Demand	moderate
Pond	Oxygen Demand	slight
Nutrient management	Oxygen Demand	substantial
Use Exclusion to exclude livestock from streams	Oxygen Demand	slight-moderate
Fencing to distribute grazing	Oxygen Demand	neutral
Filter strip/buffers	Oxygen Demand	substantial
Prescribed grazing	Oxygen Demand	slight
Forage harvest management	Oxygen Demand	slight
Pasture and hayland planting	Oxygen Demand	slight
Irrigation water management	Oxygen Demand	slight
Waste utilization	Bacteria	neutral
Pond	Bacteria	slight worsening
Nutrient management	Bacteria	slight
Filter strip/buffers	Bacteria	slight
Spring development to distribute grazing	Bacteria	slight
Irrigation water management	Bacteria	substantial

6.2 Urban BMPs

Preventing NPS pollutant loading in urban areas of the watershed involves managing existing sources of pollution and preventing new ones. NPS pollution is driven by stormwater runoff, therefore BMPs should be focused on management strategies that prevent or reduce sources of NPS pollution. Increasing the public's level of environmental awareness is the first step for solving these types of problems in the urban areas of the watershed. Another consideration is current and future development in the watershed that may cause a NPS load. Decisions regarding land-use planning and protection of urban water resources are usually governed at the municipal level. For controlling sources of NPS pollution, BMPs are best implemented through site plan controls, stormwater management plans, subdivision agreement, local ordinances, and erosion and control guidelines and standards. When attempting to implement such BMP programs, success will depend upon whether the local public has a clear understanding of the program, its overall goals and objectives. Examples of these objectives include measures such as:

- Minimize impervious areas to decrease runoff quantity and quality from source areas
- Conserve the critical and sensitive areas of the watershed
- Protect local streams and rivers from adverse effects of urbanization
- Preserve open-space land for aesthetics and recreation while also preserving water quality
- Provide fair sharing of costs and benefits of protecting water quality

Table. 10 Percentage of Pollutant Removal using Common Urban BMPs

BMP	Total Suspended Solids	Total Phosphorus	Nitrate and Nitrite
Dry Ponds	47%	19%	4%
Wet Ponds	80%	51%	43%
Infiltration Systems	95%	70%	82%
Filtration Systems	86%	59%	-14%
Bioswales	81%	34%	31%
Wetlands	76%	49%	67%

6.2.1 Public Education and Participation

Public education and voluntary action are important components of watershed protection and water quality improvement. Public education should begin before BMP implementation occurs because it will be critical during implementation. Citizens, particularly property owners, need to know the objectives for implementing BMPs, the benefits to the community and to themselves, and ways in which they can participate. Citizens generally respond positively when they understand what is occurring and why. Conversely, the public may react negatively to programs or activities to implement BMPs when they are poorly informed about why they are needed. Public awareness affects the acceptability of mandatory controls, the effectiveness of voluntary measures, and the degree of support provided by elected officials. A public education campaign can improve the feasibility of implementing BMPs to protect water quality and is critical for effective implementation.

6.2.2 Lawn BMPs

Nutrient levels in urban streams, of course, represent a composite of many different sources and pathways, of which lawn care is but one. However, the runoff coming off lawns is known to contribute to some of the highest NPS pollutant loads in an urban area such as fecal coliform and nutrients. Homeowners have an important role to play in residential source control. Less lawn fertilizer, more pet clean-ups, bio-degradable/phosphate free car wash products and more frequent driveway sweeping could collectively reduce NPS pollutants resulting from residential lawns areas. People should practice picking up their pet waste each time they take them out for a walk and properly disposing of it. The lawns in urban areas are usually landscaped with beautiful and exotic plants and grasses that often require large amounts of nutrients and water, which can cause polluted runoff. Instead, lawns should incorporate infiltration techniques that intercept and control runoff. A BMP that can be used on residential lawns is rain gardens. Rain gardens are natural depressions or can be man-made in the landscape that serve as a collection site for runoff that has been routed to them. The rain garden incorporates the use of wetland plants (facultative species), which help uptake the runoff water and return it back to the atmosphere by evapotranspiration. Another practice that is becoming more popular is to landscape with native plants. Native plants require less input in the form of maintenance and fertilizers, since they grow naturally in the local environment. Native plants used near runoff areas or in conjunction with drainage ditches and infiltration areas can function to mitigate NPS pollution at its source. Open channels can manage contaminated runoff by way of filtration, infiltration, retention, and remediation thus cleansing the water before it enters the river.

6.2.3 Street BMPs

Streets are identified as the leading source of urban NPS pollution. As stated, the amount of impervious cover strongly influences water quality. Since streets are the main conduit for public transportation in urban areas, they comprise most of the impervious cover in the watershed. Managing the pollution they contribute can significantly reduce the NPS load. Use of permeable road surfaces is another BMP that can reduce the amount of runoff due to infiltration. Another practice is proper disposal of litter and trash recycling. This will prevent trash and litter from being washed into local storm drains and into the river. For housing residents, they could practice composting techniques. This is a good way to recycle leaves, grass clipping, along with other debris, in order to keep them from being washed to the streets, into the storm drains, then into the river. Another BMP is to develop infiltration trenches or rock reed filters, where possible along the streets that serve to collect excess runoff and absorb NPS pollutants. Runoff that is flowing from streets can then be routed to such areas that are set-aside for this purpose.

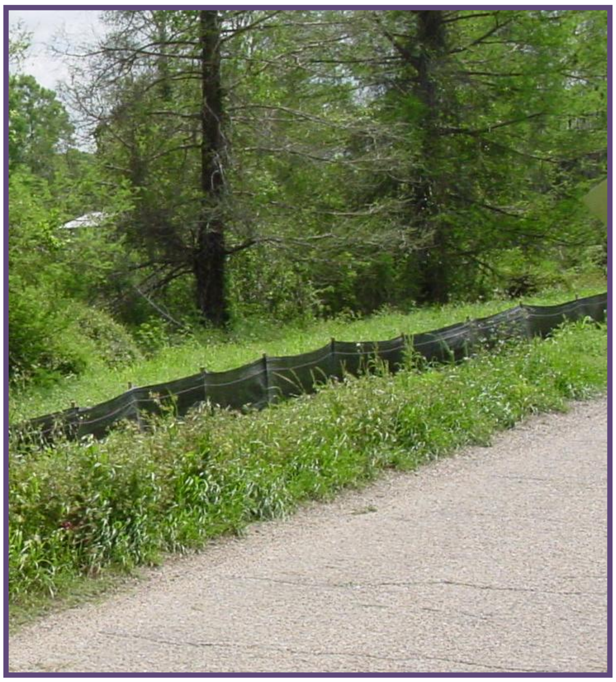


Figure 39. Silt fences are installed before resurfacing the road along the bayou.

6.3 Home Sewage BMPs

Failing home septic systems have the potential to cause significant problems in the watershed by contributing nutrients, organic matter, and fecal coliform bacteria. Prevention practices such as proper installation, location, size, and operating maintenance are the best way to eliminate NPS loads from home systems. Repairing leaking faucets and/or toilets can help avoid septic tank failure. Many of the problems that result from home septic systems occur because of lack of knowledge about the system. A way to prevent system failure is to educate the owner about the importance of maintenance. If a home sewage educational program existed, then homeowners could make better decisions during installation and operations. Once the public has been provided educational opportunities concerning their home septic systems, they may want to implement an inspection and maintenance program.

6.4 Forestry BMPs

Forestry BMPs are designed primarily to reduce the amount of sediment runoff from forestry operation sites to local bodies of water. In order to minimize the impacts of potential NPS pollutant loads into bodies of water in Bayou Maringouin and to sustain future timber harvests, operators should employ management practices that restrict timber harvest from wet areas and utilize select-cut timber harvesting practices. This approach will help maintain the important functions of the forest within the watershed while also sustaining future timber harvests.

The areas of land located along a body of water or stream bank is referred to as the riparian buffer zone, the transitional area between land and water. A riparian zone consists of land adjacent to and including a stream, river, and or other area that is at least periodically influenced by flooding in a natural state. Similar to vegetated filter strips, native plants in the riparian area effectively prevent sediment, chemicals, and organic matter from entering bodies of water. Restricting timber harvest from these areas is a BMP that forestry operations can implement, which can significantly control NPS loads from the site and protect water quality. Unlike filter strips, riparian zones are composed of higher order plants, such as trees and shrubs, as well as grasses, legumes, and wetland plants. Vegetated filter strips can be used in conjunction with riparian areas as an initial filtering component for sediment runoff from a timber site.

Other practices that can be implemented to reduce both direct and indirect NPS loads are "select cut techniques" and "no tree felling within wet areas". Utilizing select cut techniques helps maintain sustainable forestry operation without impairing its functions in the local environment. A comprehensive list of forestry BMPs with explanation and illustrations of forestry practices is found in the *Louisiana's Forestry BMP Manual*.

Effective implementation of BMPs will require programs that provide technical information, facts, and incentives for helping foresters. These programs should be designed to create awareness and participation in BMP implementation. LDEQ continues to work cooperatively with all the local and state forest entities to provide statewide forestry educational programs. A list of program activities for forestry is included in the *Louisiana's Nonpoint Source Management Plan, 2000*.

6.5 Hydromodification BMPs

Reducing the NPS load caused by hydromodification will involve managing all of the ditches and the one tributary in the watershed in such a way that they properly function without degrading or becoming unstable. Traditional hydromodification practices have proved costly, have high operating and maintenance costs, and have impaired the stream function and its designated uses. Proper management of these waterways involves balancing multiple resource uses and the ability to predict responses of the river or waterway imposed to change. Reliable prediction requires a clear understanding about the functions of a drainage way and the physical variables that influence its behavior. Historically, when the bayou existed in a natural state, it provided fish and wildlife, transportation, recreation, and drainage. Today, the bayou has been modified to a point where it only provides drainage.

Removing the weir and installing culverts under the dam-type driveways is necessary to restore a natural flow to Bayou Maringouin. Recently there has been a resurgence of river restoration projects using natural channel design techniques in an effort to improve, mitigate, or to enhance lost water resources. These efforts result in a more stable stream that resists degradation over time and function for multiple uses. The challenge will involve the coordination and support of all the interest groups and disciplines dealing with drainages in the Bayou Maringouin Watershed. Communication between the various disciplines, jurisdictions, and local stakeholders is vital for support of a channel restoration project. However, utilizing natural channel design techniques and stream restoration projects can be an effective way to reduce or prevent NPS loading resulting from stream hydromodification activities.

6.5.1 Man-made Freshwater Diversion

Freshwater diversions are another form of hydromodification and it can become a source of NPS pollutant loading if not done properly. Diverting freshwater from another river can cause problems when it enters the slow moving waters of Bayou Maringouin. It may be possible to divert water from Bayou Grosse Tete into Bayou Maringouin. However, the diversions need to be operated so that the flow of Bayou Maringouin is maintained at an optimum level such that nutrients and sediments do not accumulate, but not at an excessive flow rate that will cause bank instability. If the diversions do not operate continuously, it will act more like a pollutant loading instead of increasing the flow rates. A freshwater diversion project would involve the cooperation of several agencies, including the U.S. Army Corps of Engineers.

Figure 40. An alligator lurks in the thick vegetation growing in King Ditch.

7.0 Making the Implementation Plan Work

In order to implement BMPs and other conservation practices which reduce the NPS load in the Bayou Maringouin watershed so that it meets its designated uses and is no longer listed on the 303(d) list, it will be necessary to have programs that provide technical assistance, funding, incentives, as well as foster a sense of stewardship. Many of these programs that are designed to assist the landowner are already in place. The LDEQ's Nonpoint Source Unit provides monies distributed through the USEPA under Section 319 of the CWA. The funds are utilized to implement BMPs for all types of land uses within the watershed in order to reduce and/or prevent the NPS pollutants and achieve the river's designated uses. The USDA and NRCS are federal government agencies that have several such programs made available by way of the Farm Security and Rural Investment Act of 2002. These programs are made available through the local Soil and Water Conservation District (SWCD). The NRCS has a list of BMPs for almost all types of agriculture and programs to facilitate their use.

Parish-wide cooperation and coordination will be necessary in order to protect the water quality within the watershed. Though challenging, it is an opportunity and reason for leaders, officials, and local citizens to come together for a common interest. The watershed approach helps build new levels of cooperation and coordination, which is necessary to successfully control NPS loading.

7.1. Regulatory Authority

Section 319 of the Clean Water Act (PL 100-4, February 4, 1987) was enacted to specifically address problems attributed to nonpoint sources of pollution. Its objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters (Sec. 101; PL 100-4). Section 319 directs the governor of each state to prepare and submit a nonpoint source management program for reduction and control of pollution from nonpoint sources to navigable waters within the state by implementation of a four-year plan, submitted within 18 months of the day of enactment.

In response to the federal law, the State of Louisiana passed the Revised Statute 30:2011, which had been signed by the Governor in 1987, as Act 272. Act 272 designated LDEQ as the Lead Agency to develop and implement of the State's Nonpoint Source Management Plan. LDEQ's Water Quality Assessment Division was charged with the responsibility to protect and preserve the quality of waters in the State and has developed the nonpoint source management program, ground water quality program and a conservation and management plan for estuaries. These programs and plan were developed in coordination with the appropriate State agencies such as the Department of Natural Resources, the Department of Wildlife and Fisheries, the Department of Agriculture and Forestry and the State Soil and Water Conservation Committees in various jurisdictions (La.R.S. 30:20). LDEQ's Water Quality Assessment Division is responsible for managing federal funds to implement projects that will restore and improve water quality, providing matching State funds when required and complying with terms and conditions necessary to receive federal grants.

The water quality standards are described in LAC 33:IX.1101.D in chapter 11 (LDEQ, 2003). These standards are applicable to surface waters of the state and are utilized through the waste load allocation and permit process to develop effluent limitations for point source discharges to surface waters of the State. The water quality standards also form the basis for implementing the best management practices for control of nonpoint sources of water pollution.

Chapter 11 also describes the anti-degradation policy (LAC 33:IX.1109.A.2) which states that the administrative authority will not approve any wastewater discharge or certify any activity for federal permit that would impair water quality or use of state waters. Waste discharges must comply with applicable state and federal laws for the attainment of water quality goals. Any new, existing, or expanded point source or nonpoint source discharging into state waters, including land clearing, which is the subject of a federal permit application, will be required to provide the necessary level of waste treatment to protect state waters as determined by the administrative authority. Further, the highest statutory and regulatory requirements shall be achieved for all existing point sources and best management practices (BMPs) for nonpoint sources. Additionally, no degradation shall be allowed in high-quality waters that constitute outstanding natural resources, such as waters of ecological significance as designated by the office. Those water bodies presently designated as outstanding resources are listed in LAC 33:IX.1123.

7.2. Actions Being Implemented by LDEQ

The LDEQ is presently designated the lead agency for implementation of the Louisiana Nonpoint Source Program. The LDEQ Nonpoint Source Unit provides USEPA §319(h) funds to assist in implementation of BMPs and to address water quality problems on subsegments listed on the §303(d) list or those subsegments which are located within Category I Watersheds as identified under the Unified Watershed Assessment of the Clean Water Action Plan. USEPA §319(h) funds are utilized to sponsor cost sharing, monitoring, and education projects. These monies are available to all private, for profit, and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, federal agencies, or agencies of the State. Presently, LDEQ is cooperating with such entities on nonpoint source projects which are active throughout the state.

One example of a LDEQ 319 project in the Terrebonne Basin was entitled “Urban BMP Training and Education and Home Sewerage Education Awareness.” The goal of this project was to implement an educational program along with an accompanying video. It also installed construction BMPs at a new South Central Planning Development Commission building site, and implemented an educational awareness program to help inform local citizens and parish officials on sewerage pollution problems.

7.3. Actions Being Implemented by other Agencies

The U.S. Department of Agriculture (USDA) and Natural Resource Conservation Service (NRCS) offers landowners financial, technical, and educational assistance to implement conservation practices and/or BMPs on privately owned land to reduce soil erosion, improve water quality, and enhance crop land, forest land, wetlands, grazing lands and wildlife habitat. The new “Farm Security and Rural Investment Act of 2002”, known as the 2002 Farm Bill provides funding to various conservation programs for each state by way of the NRCS and the State’s local Soil and Water Conservation Districts (SWCD).

Although most of these programs are designed to assist the agriculture industry, there may be cases where they may be utilized for conservation practices for other types of land uses. A complete list of agriculture BMPs is provided by the NRCS in their "Technical Guide Handbook". The handbook includes a description of each BMP and their recommended uses. Each BMP is listed by a "code", i.e. Field Border (386). The following includes a brief summary of the programs available through the local SWCD under the oversight of USDA and NRCS. The descriptions of the programs are general and are based on information available at the time; key points subject to change as rules established.

2002 Farm Bill Conservations Programs and Potential Funding Sources:

Environmental Quality Incentive Program (EQIP) provides 75% - 90% cost share for environmentally beneficial structural and management alterations, primarily 60% to livestock operations. Applications prioritized for benefits. Considered the "Working Lands" program. 2008 Farm Bill total funding allocation is $13,546,218. Iberville Parish has 7 applications and 2 contracts, covering 203.3 acres and using $52,736 (livestock BMPs).
Pointe Coupee Parish has 16 applications and 7 contracts, covering 681 acres and using $90,547 (228.2 acres livestock, 452.8 cropland/forest).

Wildlife Habitat Incentive Program (WHIP) provides 75% - 90% cost share for the costs of wildlife habitat restoration and enhancement on private lands. Eligible to private property owners (and lessees) for installing riparian buffers, native pine & hardwoods, wildlife corridors, and other wildlife enhancing measures, 5 – 10 year contracts. 2008 Farm Bill total funding allocation is $660,314. Pointe Coupee Parish has 3 applications and 1 contract, covering 73.9 acres.

Wetland Reserve Program (WRP) is a voluntary program for wetland restoration, enhancement, and protection on private lands. WRP provides annual payments and restoration costs for 10 year, 30 year, or perpetual easements on prior converted wetlands. Louisiana leads the US in WRP participation. 2008 Farm Bill has applied 8,101 acres in this program and expanded the program to purchase long-term easements and cost sharing to agriculture producers.

Conservation Reserve Program (CRP)
The 1985 Farm Bill established CRP as a voluntary program to protect highly erodible and environmentally sensitive lands. Has a positive value on rural environment by improving soil, water, and wildlife. Extends a pilot sub-program called the Conservation Reserve Enhancement program. 2008 Farm Bill has applied 36,734 acres in this program.

Conservation Security Program (CSP) is a new national incentive payment program for maintaining and increasing farm and ranch stewardship practices. The CSP is designed to correct a policy disincentive in which independently conducted resource stewardship has disqualified many farmers from receiving conservation program assistance. Features an optional "tiered" level of farmer participation where higher tiers receive greater funding for greater conservation practices. 2008 Farm Bill has applied 65 acres in this program.

Grassland Reserve Program (GRP) is a new program to enroll up to 2 million acres of virgin and improved pastureland. GRP easements would be divided 40/60 between agreements of 10, 15, or 20-years and agreements and easements for 30-years and permanent easements to restore grassland, rangeland, and pasture through annual rental payments. 2002 Farm Bill established GRP and authorizes $254 million in funding for 2 million acres through 2007.

Small Watershed Rehabilitation Program (SWRP) provides essential funding for the rehabilitation of aging small watershed impoundments and dams that have been constructed over the past 50 years. 2002 Farm Bill the established program and the total funding allocation is $275 million through 2007.

“Sodbuster” is a conservation compliance requirement that was established by the 1985 Farm Bill to discourage plowing of erosion-prone grasslands for use as cropland. Eligibility for program benefits is tied to an approved conservation plan. Compliance is required.

“Swampbuster” was established in the 1985 Farm Bill as a conservation compliance mechanism to discourage draining of wetlands for use as cropland. Eligibility for program benefits can be lost for any wetland converted after 12/23/85. Compliance is required.

In addition to the programs mentioned, the following organizations have signed an MOU with LDEQ within the state’s NPS Management Plan that each will aid LDEQ in achieving the goals of the management plan:

Louisiana Department of Agriculture and Forestry
Louisiana Department of Health and Hospitals
Louisiana Department of Wildlife and Fisheries
Louisiana Department of Transportation and Development
Louisiana Department of Natural Resources
Louisiana State University Agricultural Center
Natural Resources Conservation Service
USDA – Farm Services Agency
Louisiana Forestry Association
US Fish and Wildlife Service
USDA Forest Service
US Army Corps of Engineers
US Geological Survey
Federal Emergency Management Agency
Louisiana Farm Bureau Federation

As mentioned earlier in the plan, the Master Farmer Program (developed by Louisiana State University Agricultural Center) is to encourage on-the-ground BMP implementation with a focus on environmental stewardship. The LSU AgCenter is promoting the Master Farmer Program to help farmers address environmental stewardship through voluntary, effective, and economically achievable BMPs. The program will be implemented through a multi-agency/organization partnership including the Louisiana Farm Bureau (LFB), the Natural Resources Conservation Service (NRCS), the Louisiana Cooperative Extension Service (LCES), USDA-Agriculture Research Service (ARS), LDEQ, and agricultural producers.

The Master Farmer Program will have three components: environmental stewardship, agricultural production, and farm management. The environmental stewardship component will have three phases. Phase I will focus on the environmental education and crop-specific BMPs and their implementation. Phase II of the environmental component will include in-the-field viewing of implemented BMPs on “Model Farms.” Farmers will be able to see farms that document BMP effectiveness in reducing sediment runoff. Phase III will involve the development and implementation of farm-specific, comprehensive conservation plans by the participants. A member must participate in all three phases in order to gain program status.

This program can help to initiate and distribute the use of BMPs throughout the watershed. Participants will set an example for the rest of the agricultural community and will work closely with NRCS staff and other Master Farmers to identify potential problem areas in the watershed. They will receive information on new and innovative ways to reduce soil and nutrient loss from their fields. They will be kept informed of the water quality monitoring occurring in the watershed and alerted of any degradation or improvements. Farmers, who participate and complete the Master Farmer Program, receive the distinction of a "master farmer", which implies that they have completed all the coursework in environmental stewardship, production, and management/marketing. Voluntary implementation of economically achievable and effective BMPs represents a workable means of reducing agriculture's contribution to the water quality problems.

Figure 41. The native copper iris is being choked out by invasive elephant ears.

7.4. Implementation and Maintenance

The following chart lists the average costs of installing different types of BMPs that would be useful in the Bayou Maringouin watershed.

Table 11. Cost of BMP Implementation.

Practice Code	Practice Name	Component	Unit Type	2008 State Average Cost ($)
327	Conservation Cover	Native species, 1 to 2 species (seedbed prep, seed, planting)	ac	92.00
329	Residue and Tillage Management, No-Till/Strip-Till/Direct Seed	No Till	ac	25.00
330	Contour Farming	Contour Farming	ac	5.00
338	Prescribed Burning	Prescribed Burning	ac	25.00
340	Cover crop	Establishment of small grain for seasonal cover	ac	31.00
342	Critical Area Planting	Establishment of permanent cover (seedbed Prep, seed, and seeding)	ac	210.00
350	Sediment Basin	Sediment Basin (installed, mobilization, earthwork, outlet structure)	cy	2.45
382	Fence	4 Strand Barbed Wire (materials and labor)	lf	1.63
386	Field Border	Native species, 1 to 2 species (seedbed prep, seed, planting)	ac	92.00
393	Filter Strip	Native species, 1 to 2 species (seedbed prep, seed, planting)	ac	92.00
462	Precision Land Forming	125 to 205 cy per ac (installed , mobilization, earthwork)	ac	252.00
464	Irrigation Land Leveling	125 to 205 cy per ac (installed , mobilization, earthwork)	ac	252.00
528	Prescribed Grazing	Deferred Grazing	ac	50.00
533	Pumping Plant	Nose Pump for livestock water (pump, suction hose, foot valve, platform)	ea	572.00
575	Animal Trails and Walkways	Livestock Water Access Point - all surface material types (installed, mobilization, earthwork, all materials)	sf	3.00
590	Nutrient Management	Precision Agriculture - with Yield Monitor	ac	36.00
601	Vegetative Barrier	Native species (seedbed prep, seed, planting)	lf	0.05
612	Tree/Shrub Establishment	Hardwood Bare Root Seedlings (Riparian Forest Buffer ONLY) (Planting included)	ac	135.00
614	Watering Facility	Permanent Water Trough 50 to 100 Gal (installed, materials)	ea	150.00
655	Forest Harvest Trails & Landings	Waterbar (installed, mobilization, earthwork)	ea	75.00
655	Forest Harvest Trails & Landings Wing Ditch	(installed, mobilization, earthwork)	ea	78.00
717	Livestock Shade Structure	Livestock Portable Shade Structure	sf	4.60
ac=acre ea=each lf=linear feet sf= square feet cy=cubic yard				

8.0 TIMELINE FOR IMPLEMENTATION

LDEQ has implemented a watershed approach to ambient water quality monitoring. Beginning in 2004 LDEQ changed from a five-year rotating monitoring cycle to a four-year cycle. This change allows for the same level of water quality monitoring over a shorter period of time. At the same time, it allows regional field staffs responsible for the sampling to more evenly distribute their monitoring workload. The four-year cycle will also permit a more balanced schedule of water quality assessments for Integrated Reporting (305(b) and 303(d)) purposes.

Table 12. Implementation Timeline		
Basin	First 4 Year Cycle	Second 4 Year Cycle
Mermentau	2004 -2007	2008-2011
Vermilion-Teche	2004 -2007	2008-2011
Calcasieu	2004,2005	2008, 2009
Ouachita	2004,2005	2008, 2009
Barataria	2004,2005	2008, 2009
Terrebonne	2004,2005	2008, 2009
Mississippi	2004,2005	2008, 2009
Pontchartrain	2006, 2007	2010, 2011
Pearl	2006	2010
Red	2004 -2007	2008-2011
Sabine	2006, 2007	2010, 2011
Atchafalaya	2004,2005	2008, 2009

Within each basin, all monitored subsegments will be sampled over the year or years specified under each cycle period. Water quality assessments for the Integrated Report will be conducted for each basin following the last year of its monitoring period.

Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second four-year cycle. This will allow LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list.

8.1 Tracking and Evaluation

As stated in the Louisiana Nonpoint Management Plan, program tracking will be done at several levels to determine if the watershed approach is an effective method to reduce nonpoint source pollution and improve water quality:

1. Tracking of actions outlined with the Watershed Restoration Action Strategy (short-term)
2. Tracking of BMPs implemented as a result of Section 319, EQIP, or other sources of cost-share and technical assistance within the watershed (short term);
3. Tracking progress in reducing nonpoint source pollutants, such as solids, nutrients, and organic carbon from the various land uses (rice, soybeans, crawfish farms) within the watershed (short-term);
4. Tracking water quality improvement in the bayou (i.e. decreases in total organic carbon, total dissolved oxygen) (short and long term)

5. Documenting results of the tracking to the Nonpoint Source Interagency Committee, residents within the watershed, and EPA (short and long term);
6. Submitting semi-annual and annual reports to EPA which summarize results of the watershed restoration actions (short and long term);
7. Revising LDEQ's web-site to include information on the progress made in watershed restoration actions, nonpoint source pollutant load reductions, and water quality improvement in the bayou (short and long term).

Figure 42. The muddy water in the bayou is caused by suspended sediment in stormwater runoff.

9.0 SUMMARY OF THE WATERSHED IMPLEMENTATION PLAN

In order to restore accepted water quality parameters in the Bayou Maringouin Watershed, it will require a concerted effort from all of the stakeholders within it, including government (local, state, and federal), private and public groups and local citizens. A person who lives there and/or owns property in the watershed is a stakeholder and stands to benefit from their contribution toward protecting it. Public education is the first critical element for accomplishing goals and objectives, because it is necessary that they understand and support efforts to implement BMPs. Successful outcomes are more likely, when citizens understand what is occurring and why.

The primary land use in the watershed is agriculture and forest land. Each type of land use that is identified within the watershed has BMPs that are known for reducing NPS pollutants loads and therefore increasing D.O. levels. Prevention of sediment runoff and runoff containing excess nutrients from land use activities occurring within the Bayou Maringouin Watershed will make D.O. water quality improvements in the bayou. Restoring natural flow through the bayou will also lead to improved DO levels in the bayou. Improved D.O. water quality will help to achieve and to sustain the bayou's designated uses, which in turn benefits other natural resources and future generations to come. Unfortunately, the TMDL report for this bayou shows that even a 100% reduction in man-made nonpoint source pollution will not be enough to achieve its designated uses.

Although some of the BMPs and the recommended course of actions were described within this plan, a consolidated list of BMPs recommended for each of these land uses can be viewed in the State of Louisiana Water Quality Management Plan, Volume 6, Louisiana's Nonpoint Source Management, 2000 located online at http://nonpoint.deq.louisiana.gov/wqa/NPSManagementPlan.htm.

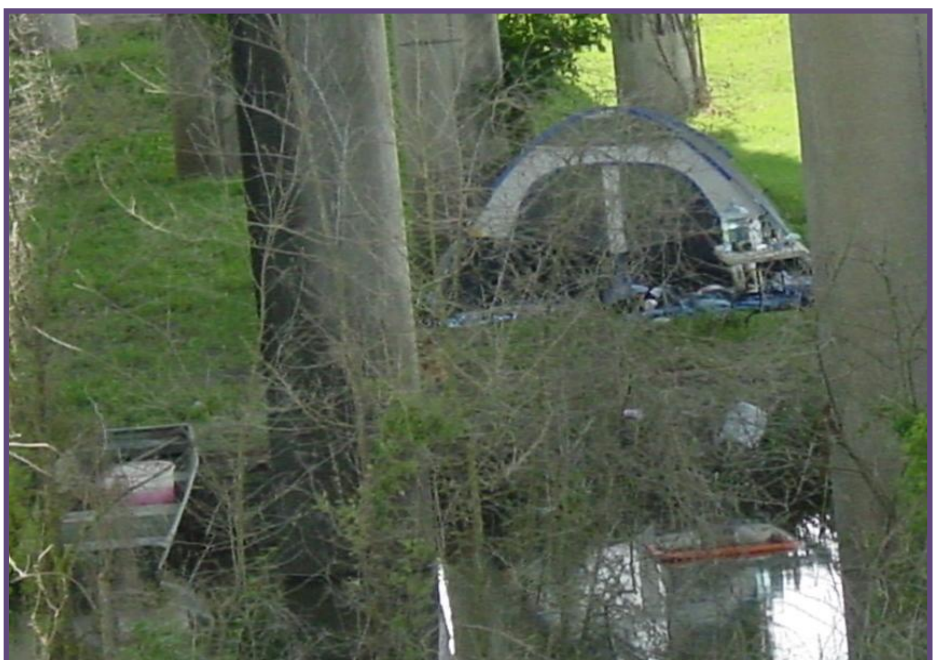


Figure 43. Camping along the EABPL Borrow Pits.

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For more information about the Bayou Maringouin Watershed and how you can help improve your local water quality, please contact the LDEQ Nonpoint Source Pollution Unit at 225-219-3595.